Complete automation of postal delivery system implies integrating many different aspects starting from collecting the mail deposited in letter boxes, to automatically reading the addresses, then providing the automation support to forward the mail to destination place, subsequently to the delivery post office and further onto the postman concerned for delivery. Most of the research efforts reported in literature refer to the postal automation in advanced countries. On the contrary the scenario in India offers diverse problems in realizing total postal automation. This research is an effort towards developing novel computational strategies for the automation of the entire gamut of operations in conveyance of mail, particularly keeping in view the complexities that arise in the Indian context.

Typically any major post office generally has two roles to play, one as an originating and forwarding post office, the other as a distribution and delivery post office. In both the cases address reading is the most vital task, which should inspire an automation expert. However in either case the way an address is read has a different objective. In this context one can easily observe that a lot of local expertise exploiting the specific domain knowledge referred to as local knowledge has evolved over a period of time in every post office, which has resulted in achieving higher efficiency in reading addresses and delivering mail. This acumen has been richly employed in this research in designing more efficient and novel computational strategies for automating tasks such as quick reading of address words, mapping of postal addresses to delivery points and finding the best practically viable path for distribution of mail.

Address reading, address validation for dispatch, mapping of addresses to delivery points and finally coming out with the practically best traversal paths for postmen are different aspects of postal delivery system researched in this work. Development of efficient computational strategies for these tasks of postal delivery system has depended upon research inputs from different disciplines of Computer Science and Engineering namely Pattern Recognition, Image Processing, Document Image Analysis, Artificial Intelligence and Knowledge based Systems, Soft Computing (Symbolic Data Analysis, Fuzzy Systems, Genetic Algorithms and Neural Networks), Geographical Information Systems, Graph Theory, Operations Research and so on. The computational strategies are developed considering post office/s in Karnataka state of India as a case study, and the strategies can be customized to any other post office.

The different research contributions presented in this thesis are organized into three parts. Part I describes the computational strategies devised for extraction and reading of postal address from mail pieces (Chapters 2-5), part II presents the intelligent methodologies developed for validation of postal address and mapping of address to mail delivery point/s (Chapters 6-8) and part III reports the new computational strategies devised, to find the best path for distribution of postal mail on a day-to-day basis (Chapters 9-11).
In Part I intelligent computational methodologies for reading postal addresses in Kannada and English language scripts, which are the predominant scripts utilized in writing postal addresses on mail processed by the post offices in Karnataka state of India, are presented. An intelligent methodology for identifying the script of the postal code (PINCODE) using newly defined texture features is devised. Further computational mechanisms akin to human approaches are developed for quick reading of printed/handwritten address words. In these techniques local expertise/local knowledge is extensively used. The techniques employ geometrical features drawn from different zones of the word image and their symbolic representation to quickly identify the word from a limited lexicon using newly defined symbolic similarity measures and other soft computing techniques. Some novel techniques for reading PINCODE printed in English/Kannada scripts are devised. Thrusting to remain adhered to the major objective of research towards realizing complete postal automation, it is purposefully avoided to get into finer computational aspects with regard to extraction of destination address block, script recognition, text recognition, numeral recognition etc.

In Part II new computational strategies developed for validation of postal address for dispatch and mapping of address to mail delivery point are included. A knowledge-based methodology using frame representation is formulated for labeling of address components and validation of the PINCODE with respect to other components in the address. A fuzzy-symbolic methodology is developed for labeling of address components using symbolic object representation of the postal address and a newly devised symbolic similarity measure. A symbolic data analysis approach to address validation and sorting of mail is also proposed. A novel soft computing technique is developed for mapping the postal address to mail delivery point/s.

In Part III efficacious computational strategies to find the best route for distribution of postal mail on a day-to-day basis are presented. The computational methodologies make use of a newly defined Geographical Information System representation of the mail delivery points and other relevant entities. A new computational methodology for finding the optimal path for distribution of mail employing genetic algorithm and graph theoretic techniques is devised. Further a practically viable path for distribution of mail using traverse-park-distribute strategy is worked out using a GLOCAL (Global+Local) approach. The methodology automatically clusters mail delivery points in close proximity and finds optimal paths in each cluster using a new steady state genetic algorithm. In sequel an optimal global path for visiting all the clusters and mail delivery points is computed.

In the first chapter (Chapter 1) while providing an introduction and presenting the state of the art in related areas we have outlined an anticipated Integrated Postal automation system and in the last chapter (Chapter 12) while concluding and outlining future avenues of research we have proposed an overall scheme for integrated postal automation.