

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENT

8.1 CONCLUSION

Novel materials with flexible and stretchy properties have emerged. coupled with advancements in processing technologies, have paved the way for the development of new connected devices and applications. PE stands out as a promising alternative to traditional electronic manufacturing processes. PE uses standard graphic arts printing techniques to produce a wide array of electronic devices on organic, rigid, or flexible substrates. This technology offers some unique features such as versatility in surface selection. Ease of production Cost-effective mass production and, in addition, PE has significant potential to provide biodegradable, recyclable solutions. This will help solve the urgent problem of e-waste generated from disposable electronic devices in PE production. The process has three main steps: material selection, printing and post-printing conductive ink plays an important role in PE, whose quality has a huge impact on the final product. For this reason, choosing a conductive irrigation system is paramount. This depends on the intended use to achieve high quality printing results.

The first phase of research was on the design of an electrically conductive irrigation system in PE. The recommended system uses SVM and MLPNN separately to select the appropriate ink for the printing application. The system selects the carrier ink based on the input characteristics the effectiveness of the model is verified using hidden layers hidden nerve cells and different numbers of training and testing samples. The experimental results prove that MLPNN can effectively select conductive inks for PE compared with SVM.

The second phase of the research attempts to develop an optimal model for conductive irrigation in PE with the help of ANN and metaheuristic algorithms. Initially, the hidden layer Output Layer and the input layer is used to build the MLPNN. Physical features serve as the input the MLPNN is trained using the PSO algorithm to capture the complex relationships between the input features and the output variables. A variety of hidden layers, neurons, training and testing samples were used to evaluate the effectiveness of the PSO-MLPNN model. The results show that the performance of the PSO-MLPNN model is better than standard MLPNN in all metrics.

Phase 3 research aims to develop a deep learning model for selecting suitable flux ink in PE. In this model, 1D CNN is used for selecting conductive ink for printing the performance of the model is analyzed and compared with MLPNN and PSO-MLPNN. The results show that the 1D CNN model outperforms MLPNN and PSO-MLPNN in all metrics. Moreover, a significant improvement in the performance parameters makes the performance of the 1D model. CNN is stronger in the case of conductive irrigation. These improvements emphasize the robustness and reliability of the model strengthens its suitability to deal with challenges inherent in PE applications.

The performance of the three work in which Support Vector machine(SVM), Multi-layer Perceptron Neural Network (MLPNN), Particle Swarm Optimization –MLPNN(PSO_MLPNN) and 1D Convolutional Neural Network (1D CNN) were used and evaluated based on various performance metrics. First work achieved an accuracy of 91.67% with recall metric of 95%. The second work in which PSO has been implemented where the accuracy metric is increased to 94.48%. During the final work the accuracy score for 1D CNN is 98.29% was achieved. In terms of recall, 1D CNN gets a percentage of 98.86. The F1 score of 1D CNN shows about 97.74%. Finally, the 1D CNN model consistently outperformed the other models across all metrics in selecting the conductive inks for various Printed Electronics applications.

8.2 FUTURE ENHANCEMENT

The research focuses on developing an automated system for selecting suitable conductive inks for printing. Research is also attempting to improve the accuracy of the model. The research contributions described above can be expanded as follows.

- ❖ Investigate the efficacy of other ANN architectures in conductive ink selection for PE.
- ❖ Expand the range of material characteristics considered in the selection process to further enhance the accuracy and versatility of the models.
- ❖ Incorporate larger and more diverse dataset to analyse the performance and generalization capabilities of the developed models
- ❖ Explore the integration of other source information to improve accuracy and reliability of the models.