This thesis presents a novel analysis and classification of human radiation wave for gender and body segments recognition. The human body has been shown to emit radiation into space surrounding their body. The research study frequency radiations at 23 points of the human body segregated into body segments of Chakra, Left, Right, Upper body, Torso, Arm and Lower body. Initially, the characteristics of frequency radiation are examined using statistical tools to find the correlations between variables. Multivariate analysis of variance (MANOVA) is employed to compare the differences of frequency radiation characteristics between genders. Then, the classification algorithm of $k$-nearest neighbor (KNN) is employed to discriminate between genders, and between body segments. The classifiers are evaluated through analysis of the performance indicators applied in medical research of accuracy, precision, sensitivity and specificity in receiver operating characteristics (ROC) analysis. The findings obtained from this research show that the wave radiation characteristics of a male and a female human body are different. The proposed technique is able to distinguish gender and classify body segments, and it is justified using MANOVA statistical tests. The individual features of gender differences using analysis of variance forms a significant outcome on 13 points that are located close to the forehead, left and right side of abdomen, palms, arms, shoulders and head. In KNN classification, the outcomes for the classifiers are consistent with the MANOVA. For gender recognition, the classifiers have successfully differentiated male from female human body, and achieving a performance of 100% for accuracy, sensitivity and specificity. For body segment recognition, the classifiers are also able to distinguish between the body segments producing 100% accuracy in classifying of Chakra, Left and Right, whilst 93.75% accuracy is obtained in classifying of Upper body, Torso, Arm and Lower body. The sensitivity and specificity computed for body segment recognition are found to be more than 80% indicating a good classification performance. The outcomes of this study demonstrate that a male and a female human body, and also the different body segments, have different frequency radiation characteristics. The finding offers new opportunities in research and application based on human body radiation such as biometrics and surveillance systems.

Steam distillation is the most popular technique used in the industry for extraction of essential oil. The main contributing factors are the system cost, cleanliness, productivity, operational cost and the maintenance cost. In extracting the essential oils, several factors have been identified to have great influence on the extraction yields and quality. The extraction temperature is regarded as the most significant parameter that contributes to the amount of output yield and quality of oil. In conventional steam distillation system, electric heater or gas was commonly used as the heating source. However, some drawback was observed during application of electrical heater or gas and it’s also lacks of temperature control in order to satisfy the essential oil extraction process requirement. Based on the literature reviews, this research proposed an application of self-tuning fuzzy PID (STFPID) integrated to the induction based steam distillation system to regulate steam temperature for the essential oil extraction process. A new method for steam distillation system had been developed by replacing induction heating system as their heating source. The modeling works have been carried out to understand the plant characteristic and behavior. The ARX structure with first order model was chosen to represent the system dynamic for simulation studies. The STFPID controller was designed for the obtained plant model. Real-time implementation of the simulated STFPID controller has been carried out and the performance of the proposed controller was evaluated. Proposed controller has been benchmarking their performance with HFPPID and PID controllers. Results shows that STFPID controller has the ability to improved process rise time, settling time and reduced process overshoot compared to HFPPID and PID controllers.