Wireless ad hoc networks have attracted the attention of many researchers due to its various implications from the battlefield coordination to extension of mobile network service area. The main contributor to their attraction is their lack of infrastructure requirements. The participating devices themselves become the infrastructure of the network as well as play the role of the end user devices depending on where it is located at a given time. If two network devices are out of each other’s transmission range they can use the devices that are between them as a communication medium. Other attractions to this technology include their dynamicity and the vast number of application possibilities. But this attractiveness comes with its associated disadvantages such as connection unreliability, bandwidth limitation, transmission error rates, security issues, power shortage, low processing and memory capabilities. Apart from the difficulties the ad hoc networks face, it can still be very useful in environments that the shortcomings are less visible.

In recent times wireless communication devices have become common in everyday life. The number of wireless devices in the home environment has also risen. This trend continues to introduce wireless capabilities to household appliances and sensors as well. Most devices at a household remains at one point in the house such as television, refrigerator etc., where as some devices such as smart phones, laptops etc. has no fixed point. Creating a network of such devices at home would greatly assist the users to control and monitor their household environment.

The appliances and sensors in a household may not come from the same manufacturer thus the capabilities of the wireless modules such as transmission distance, processing power and memory etc. may also differ. Therefore it is also important to address the heterogeneity of the network nodes. The network should work under resource restricted conditions thus preventing less resourceful nodes forming bottlenecks or causing performance degradation. Such an environment creates ideal conditions to use an ad hoc network with the benefit of no extra cost for new equipment where the heterogeneity of nodes can also be supported.

This research proposes the use of an ad hoc network of wireless enabled home appliances and sensors to extend their capabilities to provide convenience in everyday life. Such a home network will allow the user to coordinate and control home appliances and sensors through other appliances or sensors from anywhere in the network.

The usability of this network is considered as an important factor, as the user may have interactions with home appliances and sensors (termed nodes hereinafter) such as issuing commands, receiving messages, etc. Therefore it is important for the user to have the ability to quickly identify the nodes. For ease of node identification, this research proposes the use of actual names that would be used in everyday life such as "kitchen oven, bedroom light" etc. to identify the appliances and sensors. The addressing will be unicast or multicast depending on the number of nodes with a similar name.

Consider a system where the default names are already given by the manufacturer which may consist of the brand and model name etc. A user interface device (smart phone, laptop etc.) allows the user to see a list of compatible devices in the communication range. The user can change the default names of the nodes as preferred. The user will select multiple nodes and assign a common location name. After this simple procedure is repeated at other locations or rooms, the nodes will automatically complete the setup of the home network. Also nodes joining the home network later require no user intervention other than changing the default name if desired. This research also proposes a method of location name discovery using the received signal strength of a node’s neighboring nodes.

In the home environment the appliances and sensors can be considered as a group depending on their location in the house, such as dining room, kitchen and bedroom, etc. In such an environment, a cluster-based network can be implemented with its advantages such as lower control overhead. This research proposes and discusses the formation of the clusters based on their location names and priorities of the nodes. The research also proposes a priority calculating scheme based on the processing capability, memory capacity, transmission power and power consumption of a node. The use of the difference in location names to identify each cluster separately is also proposed. A node from one cluster is able to identify whether another node is from the same cluster or not, based on the location name. This feature is used to identify the nodes that are located between two clusters and hence form the network.

The home network user needs to interact with the nodes in order to monitor and control the home environment. Therefore messages must be sent and received to a device with a user interface. The routing of these messages in the network is also important as the user perception of the home
environment requires accurate and up-to-date information. A specially organized routing cache is proposed to assist message routing using limited memory capacity. This research proposes three message routing schemes based on the proposed routing cache: Single Routing Cache, Equal-Sized Directional Routing Cache and Proportionally Sized Directional Routing Cache. The research also compares the performance of each proposed message routing scheme through simulation.

Although most home appliances stay at a single location such as lights, refrigerator etc., some nodes such as laptop, smart phone etc. freely move in the home network. This research proposes algorithms to maintain network topology while allowing nodes to move freely in the home network. A message routing scheme capable of handling the mobility of nodes is also proposed and discussed. Three optional routing mechanisms that consider the transition time of a node between two clusters are also proposed and evaluated.

The research also investigates the possibility of implementing a routing protocol using a counting bloom filter as a routing cache for the home network. Algorithms are proposed for updating the routing information of the nodes in the home network. Two strategies of using the name-based addressing scheme to store node names as routing information in the counting bloom filter are proposed and evaluated.

Finally the research work is concluded and the future extensions of this research are stated towards creating a network of home networks and grant the user the ability to access the home network from anywhere in the world.