Feasibility Study

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Degree course: Computer Science

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# Project title: Developing an IoT Mobile Application for Controlling and Monitoring a Smart Home Automation System for the Blind and Visually Impaired

## Course-Specific Learning Outcomes

• Use knowledge, abilities and skills for further study and for a range of

employment in areas related to scientific and technical computing.

• Interpret legislation appropriate to computer professionals and be

aware of relevant ethical issues and the role of professional bodies.

• Analyze, design, and implement algorithms using a range of appropriate languages and/or methodologies.

• Design, implement and interrogate database systems.

• Demonstrate effective communication, decision making and creative

problem solving skills, and identify appropriate practices within a professional, legal and ethical framework.

• Critically appraise and apply suitable artificial intelligence techniques

for a variety of software systems.

## Project Background

Smart home automation systems have become increasingly popular in the last decade due to the arrival of the Internet of Things (Ali 2020). The Internet of Things is an “interconnection of sensing and actuating devices providing the ability to share information across platforms through a unified framework, developing a common operating picture for enabling innovative applications. This is achieved by seamless ubiquitous sensing, data analytics and information representation with Cloud computing as the unifying framework.” (Gubbi, 2013:1647) for IoT to be able to connect such a large number of devices it needs to have a flexible and layered architecture, the most basic model of IoT consists of a 3 layer architecture which includes the Perception, Network and Application layers (Choudhary 2016).

There are many different applications of IoT including wearables, agriculture, smart grids, hospitality, connected health, smart cities and much more, but in this project, I am going to be focusing on its smart home automation applications. A smart home system is normally made up of IoT devices such as cameras, sensors, actuators, and appliances that can be accessed remotely (Rizvi 2018) as shown in Figure 1 below.

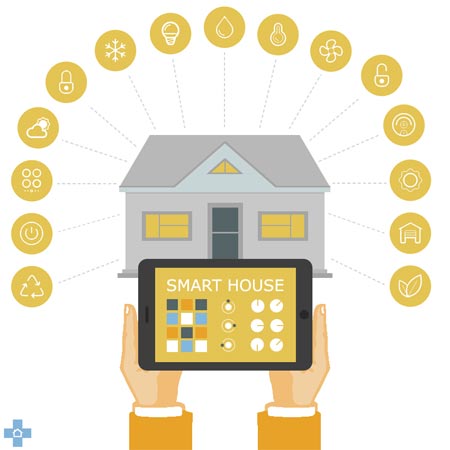


Figure 1: “The things home automation can do” (Source: Diy Doctor, 2020: online).

For IoT devices to be able to transmit data over a network they need to use certain protocols, the main protocol I will be focusing on using in the project is Message Queuing Telemetry Transport (MQTT). MQTT runs over TCP/IP and uses a publish/subscribe concept to transfer information through a broker. In my case I will probably be using a Raspberry Pi or similar as the message broker, this will enable all devices in the smart home and also the Android application to be able to communicate with each other as they will each be able to publish information to the broker or subscribe to receive information.

Smart home systems can increase the quality of life for some (Miah and Khan 2019), especially for certain groups of people such as the blind and visually impaired. For instance, if a blind or visually impaired person needed to use one of the devices or appliances in their home, lock/unlock the doors or control the temperature/lights they can do so using a voice command through a smart home control application, this cuts out the need for any physical interaction making the task significantly easier. Also, sensors such as motion and sound can be used to monitor the well-being of the inhabitant and detect if any assistance is needed. A huge benefit of this system is that it is much more cost efficient and favorable than having the support of a personal assistant (Rizvi 2018).

For my application I will be using Android Studio for development and I will be using the Java language as opposed to Kotlin. For voice recognition I will be using the Android Voice Recognizer Library. I also am going implement an AI algorithm to recognize common voice commands, learn the necessities of the inhabitant and recognize their routine to further assist with the automation of the smart home. For the hardware I will be using a Raspberry Pi, Phidget interface kit and multiple Phidget sensors (Light, Sound, Motion, Touch and Temperature).

## Aim

The aim of this project is to design and create a functioning Android application for controlling and monitoring a smart home automation system using voice recognition. The application will be designed to be used by the blind and visually impaired to improve their quality of life and support independence.

## Objectives

* Find existing related works and Android apps for controlling and monitoring smart home systems.
* Research existing relevant IoT, Smart Home, Database, Voice Recognition and Artificial Intelligence technology and algorithms.
* Do research on the blind and visually impaired and conduct an interview or survey if possible.
* Design and Wireframe the Android application.
* Design SQL database system for user accounts/information and smart home device information.
* Design layout of the Smart Home hardware.
* Implement UI design on the Android application.
* Connect Phidget interface kit and sensors to Raspberry Pi through the MQTT protocol.
* Connect Android application to Raspberry Pi through the MQTT protocol.
* Implement voice recognition and enable users to control connected devices with their voice.
* Implement SQL database for storing individual users’ data/information and smart home device information.
* Implement AI algorithms to recognize user’s routine and behaviors.
* Thoroughly debug and test the created Android application.
* Conclude project with summary of the created application and results produced and provide suggestions for further work related to this field.

## Problems

The main problem I believe I will encounter is having low knowledge of Artificial intelligence and of Voice Recognition techniques, to resolve this I will have to conduct thorough research on both before undergoing with the rest of my project, I do however have an Artificial Intelligence Unit before my main project block which should aid in my understanding of AI. Another problem is that I have never used any smart home hardware before so again I will have to conduct through research on which hardware is suitable and how it works, also I can discuss this with my supervisor.

## Required Resources

* Android Studio
* Android Phone for Testing
* Web or MQTT Server
* Phidget interface kit
* Multiple Phidget sensors (Light, Sound, Motion, Touch and Temperature).
* Raspberry Pi.

## Schedule

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## Ethics number

2020-26247-20539

**References**

Miah, J and Khan, RH. (2019) “Service Development of Smart Home Automation System: A Formal Method Approach”. *In* *CIIS 2019: The 2nd International Conference on Computational Intelligence and Intelligent Systems*. Bangkok, Thailand, November 2019. Association for Computing Machinery. pp. 161-167. [Online] [Accessed on 8th October 2020] <https://dl.acm.org/doi/10.1145/3372422.3372437>

Ali, YM. et al. (2020) “Voice Command Intelligent System (VCIS) for Smart Home Application using Mel-frequency cepstral coefficients and linear prediction coefficients”. *In International Conference on Semiconductor Materials and Technology (ICoSeMT 2019).* 1535 012008. Penang, Malaysia. 29-30 April 2019. IOP Publishing Ltd. pp. 1-9. [Online] [Accessed on 9th October 2020] <https://iopscience.iop.org/article/10.1088/1742-6596/1535/1/012008>

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