**HOME AUTOMATION SYSTEM**

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Final Report (Draft)

The dissertation was submitted in partial fulfillment of the requirements for the B.Sc. Special Honors degree in Information Technology

BSc Special (Hons) - Information Technology

(Specialization in Information Technology)

Department of Information Technology

Sri Lanka Institute of Information Technology

Sri Lanka

September 2018

# DECLARATION

I declare that this is my own work and this Final Report does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate is carrying out the research for the undergraduate Dissertation under my supervision.   
  
   
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**Abstract**

This project revolves around creating a home automation system prototype with the main focus of having the ability to lock or unlock a door, centralized control of lighting, controlling high tech appliances through the internet to provide improved convenience, comfort, energy, efficiency and safety. The system consists of a central device, a server, sensors, and an application. The popularity of home automation has been increasing greatly in recent years due to considerable affordability and simplicity through Smartphone and tablet connectivity. The techniques employed in home automation include those in building automation as well as the control of domestic activities, such as lighting control system, and the use of other electrical appliances. When Internet of Things also known as IOT, comes to our homes, it can be widely incorporated into making our castle smarter, safe and automated.

Once the System is implemented, Home automation system should be tested to find bugs and mismatches in the requirements. Prototype installation should be inspected and tested for bugs, functionality and ease of use. Fixing a bug or adding additional functionality to an automation system can have unforeseen consequences, which would lead to costly downfalls.

As home automation apps become more intelligent, their capabilities become almost endless, from controlling lights and locks to small appliances. Instead of having different apps for different functions, our app will be able to manage everything from one place.

And most importantly, due to the increase in energy consumption, increase population, and limited time frames, there is a grave need to conserve time, effort and energy in any way possible. Henceforth, this proposed system will be cost effective, flexible, and have the capability to control and monitor the home environment, at your fingertips.

**Acknowledgement**

I would like to express my deep sense of gratitude to my supervisor *Mr.Yashas Mallawaraarchchi*, who guided me throughout this project with providing the fullest support and the maximum supervision. I am very much blessed to have you as my advisor who always respected my ideas and corrected me whenever I am wrong. Without his support, it would not have been possible to complete this dissertation with success.

Apart from him, I would like to offer my sincere gratitude to each and every person from my university and to my friends who gave me their support throughout the project.

Especially I would like to thank my parents for the encouragement and the necessities they have provided me to make this a huge success.

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# **Introduction**

This chapter introduces the background, the structure, and the aim of the project.

## Problem to Be Addressed

## Background Context

IoT aims in creating a network between objects embedded with sensors, that can analyze, communicate and exchange data together over the internet,

As this project focuses on smart home automation through IoT, smart home concept should be understood first. This combines devices, found in homes, to be able to control it.

The system designed for the home automation project that needs a control unit, a computer, to be able to control the different electrical devices connected to it. [6]

Raspberry pi was chosen to be the control unit of this project. It has GPIO pins and capable of being programmed, so it was chosen for its simplicity and capabilities. Design components used for the system are as follows.

## Research Gap

In Today’s world, with the hassle of various activities in the household; Home Automation systems are used to make everyone lives simpler, more convenient, safer, by having the ability to control appliances at the tip of our fingers.

The countless systems that are conventionally available around the globe, are relatively expensive, and therefore our proposed system, would fit into the budget of many families, who want to have more independence and control over their home, and have their mind at ease when they travel for holidays, or even leave the house in a haste and suddenly experience the feeling of dread on whether they left any appliance on or left the door, window or garage open.

## Research Questions

1. **What are the mechanisms used to detect the License plate of the passing by vehicles?**

Initially, there must be a mechanism to detect a vehicle is approaching, and then Through image Processing the License plate must be located, and captured, then it must be processed and after which the system will compare and analyze the data with the database data, for vehicle verification.

Once the License plate is recognized with a set of allowed plate; necessary action is taken, such as either the garage gate will open or the gate will remain closed.

1. **What are the mechanisms that can be used to automate the landscape lighting?**

This Functionality provides the user with automatic landscape lighting, by monitoring the intensity of natural Light. When there is low natural light, then the landscape lighting will be automatically turned on, only in selected areas of the house premises. When natural light is high, then the lights will automatically turn off.

1. **What are the challenges faced during implementation of the Hardware and software application?**

There must be a stable connection between the hardware and the software appliances. Signals and notifications must happen in both directions; therefore a full duplex connection must be successfully established. Furthermore, this connection must be secured to prevent hacking, which further leads to leaving the house vulnerability to breaking and entering.

The next challenge is mechanical, connecting the Hardware parts, i.e the sensors and the model house.

1. **What are the benefits of RPI3, over others like Arduino?**

Cheap, Small and Compact, Highly Customizable, Contains GPIO pins (Therefore it can interface with the real world.), Ability to run on any OS. Consists of Bluetooth, Wi-fi. RPI main advantage is it highly capable of handling multiple tasks at a time unlike Ardiuno. RPI has built in Ethernet port and it is also faster than Ardiuno.

# **Literature and Methodology**

## Addressing the Literature

## Methodology

This part of the document explains how the proposed system going to be designed and implemented. Functionalities and the flow will be explained clearly with the tools and technologies which are going to be used in order to achieve the objectives of the proposed system.

With so little time and so much errands to run, we as humans are always at haste with our routines, and we tend to forget to check if the garage door is closed or the light is left on; our Smart System will detect these minor details and send notifications via Server Communication to the residents, and henceforth have the ability to do the needful.

All this Communication will be handled between the app and the Raspberry Pi3, through a secured Internet Connection, that is not easily penetrable for cyber attacks.

## License plate recognition and Automatic Garage gate Functionality

Wireless Garage Gate Controllers may currently be available across the world, but with the latest IOT advancements; Our system through Image Processing, will detect the home resident’s license plate number and automatically open the garage gate when the vehicle is couple of meters from the garage. Furthermore, once the car has entered the garage, after a set time, the gate sensor will close the Garage Gate. Hence saving ample time, and effort of the user.

## Automated Landscape Lighting

Through UV light sensor detection, a light outside the Home (Porch Light) will switch on when it gets closer to dusk (Evening). This light detection mechanism will also handle the lighting system inside the Garage, i.e if there is limited light supply inside the garage, and if a person or the vehicle is entering the garage, a light will be turned on; this would not only save the person some time from finding the light switch but also avoid causing any injury.

## Research Findings

To implement the Garage functionality, the Image processing technique that is taken into consideration is Histogram of Oriented Gradients (HOG) Descriptor.

Histogram of oriented Gradients is a feature descriptor that is used to detect objects in Computer vision and Image processing. The Technique is that in a localized portion of an image, the occurrences of gradient orientation are taken into count.

HOG method is similar to shape context and edge orientation histograms, but the only difference is that it’s computed on a dense grid of uniformly spaced cells and for improved accuracy it uses overlapping normalization.

The various techniques can be used to detect the vehicle license plate which includes alpha-numeric characters and numbers is:

1. **Split and Merge Segmentation.**

Partitioning of a digital image into multiple uniform segments is done in order to simplify the representation of an image which would become more meaningful and therefore easier to analyze. Once the image is split, the smaller sections are merged to display an area of interest.

1. **Optical Character Recognition (OCR)**

This is an electronic conversion of images into a machine en-coded text. This is a common method for digitizing printed text, which then results in electronic editing and compact sorting and finally on-line displaying.

For this proposed function, OCR is used for license plate recognition.

There are three processing steps that is being accomplished to in the License Plate recognition (LPR) algorithm:

1. Extraction of license plate
2. Segmentation of the characters (alpha-numeric and numbers)
3. Recognition of each character.

When the image is captured, the license plate section is extracted and the characters are segmented. After that the individual text characters are grouped into words. The words are matched with a set of license plates stored in the database. Once the plate is verified, the garage gate will open. And after a set time, once the vehicle is inside the garage gate closes, after which the surrounding is analyzed by a Light Dependent sensor and if the lighting is limited, the garage light is automatically turned on.

# **Results & Discussion**

This section concludes the results that were achieved from the research project and the new approaches that were found to address further researches in the undergraduate context.

To test the functionality, a miniature model Home is constructed and then tested continuously to ensure the functions is operating smoothly; each member would take turns to test their functions accordingly.

Testing is conducted throughout the implementation process, and accuracy levels are taken into account. Once the System is stabilized, the functions will be tested in real world, further modifications and adjustments will be implemented accordingly.

## Evidence

## Discussion

# **Conclusion**

Expectation is to provide marketable product to the industry by including automated devices that can be accessible remotely. Following the residential market and lead it by making the product easy to install by any person who have average knowledge of technology. Our Product has the added advantage of being relatively cheaper than the similar products that are already in the market and the security implemented into the system, is far more reliable that the current Home automation appliances.

WPAN connected devices are accessible from anywhere virtually using web application, tablets or smart phones provided there is an internet connection. Ability of controlling lights from wherever the user wants, Controlling doors and windows locking system whenever wanted, Giving the access only to the white listed people, Save time and effort by controlling indoor and landscape lighting and having automated garage door functionality, Reduce electrical wastage and risk of fire by controlling the high tech appliances are major features of the IOT smart home system. The unique feature of this home Automation system, is the ability for the user to bring a new sensor into their home and configure and synchronize it with the web application, this will then give the user control of all the sensors and devices, old and new through a single application.

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# **Glossary**

# **Appendices**