Automatic Dog Door

ECE 445 Mock Design Review
Nicholas Cain, Ryan Prodoehl, and Kamil Zabawa
Team 10
TA: Yuchen He
1 Introduction

1.1 Objective

In the U.S., approximately 44% of all households own a dog [1] - with dogs comes responsibilities, such as having to get up from the couch after a long days of work to let the dog out as it needs. We believe we can provide comfort and ease to the typical american household by having an automatic doggy door that opens when the dog approaches the door so the owner does not have to worry about getting up. Our solution will also allow for dogs to use the door even if the owner is not home while minimizing security risks.

1.2 Background

Most household owners that own a dog and a backyard can get annoyed with having to get up constantly to let their dog out. Another common issue is the dog not going out enough during the day due to the owner being stuck at work. The current solution to both of these problems is the use of a rubber door that the dog can use at free will. The main issue with using a robber dog door is that burglars are more than welcome to crawl through the space [2]. This poses serious safety concerns to dog owners and results in them not purchasing a dog door.

Our solution of an electronic automatic doggy door can tackle both these problems at once while also providing additional features for user customizability. Upon an owner’s configuration, a dog would be able to use this automatic door while keeping security under control through the use of an RFID chip in the dog’s collar to ensure door use is restricted to the dog only. There already exists some on the market [3], but most are expensive and use ultrasonic sensor technology. Our solution uses different technology (RFID and IR), remains cheap, and also includes an application to provide the owner fuller customization.

1.3 High-Level Requirements

1. Door unlocks only when a dog is approaching within a meter and locks within 3 seconds of dog leaving. This is the biggest requirement for security and safety concerns, we need to ensure the dog is not approaching/leaving and not stuck within the door when attempting to lock.

2. Door remains locked if dog attempts to use the door outside the bounds of the user’s customization (weather and time). If the dog is outside when the door is locked due to user’s settings, the door should unlock and allow the dog back in but not vice versa.
2  Design

The foundation for our new design will stem from an already existing rubber doggy door that uses magnets to stay shut when no force is applied. We will use a servo motor to move a locking mechanism to block the door from opening when force is applied - the door will only be able to open when the actuator is in an UNLOCKED position. Below is a block diagram of the general overview of our system, the sensors and hardware are detailed after.

![Block Diagram](image.png)

*Figure 1*
2.1 Power Supply

Powering the system is handled by a standard AC to DC power supply that will plug into the wall outlet. This will mitigate any risk of electrocution, as we will source a high-quality, well-reviewed adapter. Since the MCU operates from ~2-3.5V, the power supply must be able to constantly supply more than the maximum power, as the MCU also features an internal voltage regulator. It must also be able to provide power to the sensors and WiFi module.

Requirement: The power supply must be rated for 6-12V, and must be able to supply 300mA.

2.2 Sensors

Our system will use a set of several different sensors in tandem to determine whether or not the door should be allowed open.
2.2.4  IR Sensor

A key concern is accidentally triggering the door to unlock when the user is walking past the door rather than straight-on towards the door. IR sensors will be used in tandem with RFID to ensure the user is heading straight towards the door. This will ensure that accidental unlocks do not occur with the system.

*Requirement 1:* Multiple sensors must be used to indicate which direction relative to the door an object is.

*Requirement 2:* Must have an effective sensing distance of 0.5-1.0 meters.

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<tr>
<th>Requirements</th>
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<td>2. Must have an effective sensing distance of 0.5-1.0 meters.</td>
<td>2. a) Connect IR sensor to power supply.</td>
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<td>b) Measure output voltage using multimeter at varying distances.</td>
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Figure 3 above depicts the output voltage characteristics of the Sharp GP2Y0A02YK0F Infared sensor.[4]
3 Safety and Ethics

There are several potential safety hazards with our project.

The principal safety hazard is potential injury to the user of the door. There is no risk of the user being crushed since the system never manipulates the door or allows the door to get in a position to crush/hit the user. Since our system is only altering the locks, the door is completely safe for the user.

Since part of the electrical system is outdoors, moisture could cause damage to the system (apart from the specific rain sensor). An enclosure will be created for all relevant electrical components that must be kept out of moisture. This enclosure will adhere to IP64 guidelines for this system.

4 References


