Day & KNight Security System

CDA4630
Introduction to Embedded System Design
Final Project Documentation

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Table of Contents

Abstract

At this time, security systems are generally built to react, rather than act, to protect a home. These systems fail to provide tactics of preventing a break-in and are unequipped to deal with animal intruders. This report describes a project that incorporates solutions to these problems through a different type of home security system. The system, uses infrared sensors, placed at a specified location in front of the house, to initially detect an intruder before the front door is even reached. It then sends a notification to the homeowner's phone and, if at night, it activates a light in front of the house and a soft-sounding alarm, emitting from a buzzer. If no action is performed and the intruder remains exceeding 3 seconds, the system will activate the sprinklers for a specified amount of time. While this is more effective in scaring away animals, it can be used for both types of intruders, human or animal. If someone approaches the door, a weight sensor will detect their presence and send a notification to the homeowner. The homeowner can then communicate back to the system and send a request to unlock the door or take the appropriate action. With this system, there would also be a device on the window, which will activate the alarm if the window is opened. All communication between the homeowner and the system is done via Bluetooth communication between an app on the homeowner's phone and the MSP430 microcontroller. With this system, a homeowner can receive constant updates on what is happening outside their home without the need for a camera and minimize the likelihood of an intruder actually breaking-in their home.

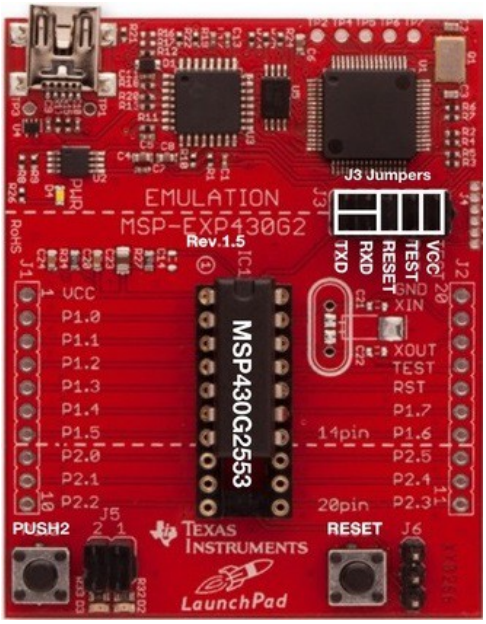
Introduction

The *Day & KNight Security System* uses infrared sensors to create an invisible beam at a specified distance from the home. When someone passes through the beam, a notification will be sent to the homeowner's phone via Bluetooth. If someone passes through it at night, a soft-sounding alarm will emit from a buzzer and the homeowner can choose to have a light turned on as well. At the discretion of the homeowner, if no action is done to deactivate the system and the intruder is still there after three seconds, the sprinklers will come on for a specified amount of time.* If someone reaches the door, a weight sensor will detect their presence and notify the homeowner via Bluetooth. Originally, the system would then use an accelerometer to determine if the person's knock matches the knock pattern saved by the homeowner and, if so, would unlock the door. Unfortunately, this feature is still under development, so, the system will only unlock the door if the homeowner confirms through their phone. If the intruder tries to open a window, the alarm will sound as well and the homeowner would be notified.

*Note: The purpose of this feature is more for scaring away animals, though it could have some success in keeping away people as well. This feature is also currently under development and will be available soon.

Design and Implementation

TI MSP-EXP430G2 LaunchPad with MSP430G2553



The MSP430g2553 is a low-power, 16-bit microcontroller with up to 16K bytes of flash memory.

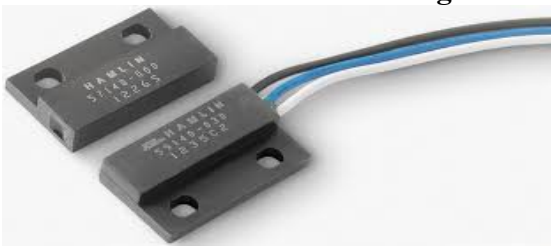
The main role of this microcontroller in the Day & KNight Security System:

The microcontroller uses its general purpose I/O peripheral:

- to read from the Force Sensitive Resistor, Infrared Sensors, and Reed Switch
- to write to the Solenoid, LED (red), and Piezo Buzzer

It uses its Serial Communication peripheral to communicate with the Bluetooth module through the UART registers. The I^2C from this peripheral will also be used during the implementation of the accelerometer feature.

Littelfuse 59140 Miniature Flange Mount Reed Sensor (switch)



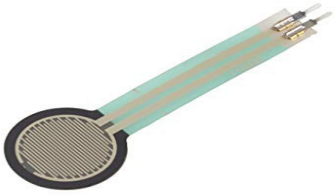
Schematics	Switch Type
Black Black	1 and 2
Black Blue White	3
Black Black	4

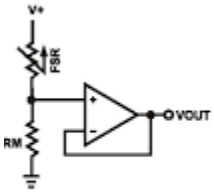
The main role of this magnetically-operated proximity sensor in the Day & KNight Security System:

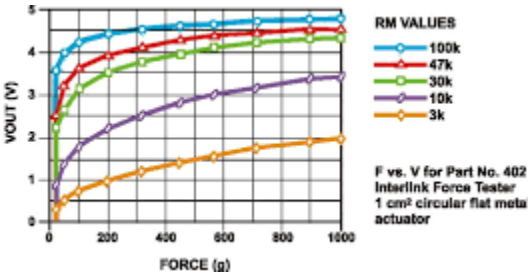
This reed switch determines whether a window has been opened and communicates the result with the microcontroller.

For more information, see datasheet:
https://www.mouser.com/datasheet/2/240/Littelfuse_Reed_Sensors_59140_Datasheet.pdf-934389.pdf

FSR402 Round Force Sensing Resistor





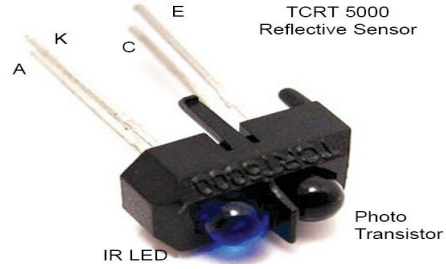


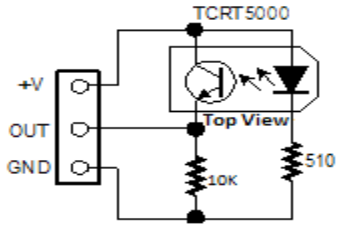
The main role of this 18.28 mm weight sensor in the Day & KNight Security System:

This sensor detects a gravitational force increase when stepped on. It then transmits this data to the microcontroller and the microcontroller, in turn, determines if the value is within a specific range, indicating there is most likely a person at the door.

For more information, see datasheet:
https://cdn2.hubspot.net/hubfs/3899023/Interlinkelectronics%20November2017/Docs/Datasheet_FSR.pdf

TCRT5000 Reflective Optical Sensor with Transistor Output



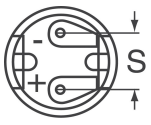


The main role of this infrared (IR) sensor in the Day & KNight Security System:

This project utilizes a receiver from one IR sensor and both the transmitter and receiver of another in order to create an invisible beam to detect when someone is entering or leaving the facility, based on the order in which the receivers transmit data to the microcontroller.

For more information, see datasheet:
https://www.vishay.com/docs/83760/tcrt5000.pdf

CST-931 AP Piezo Buzzer Transducer



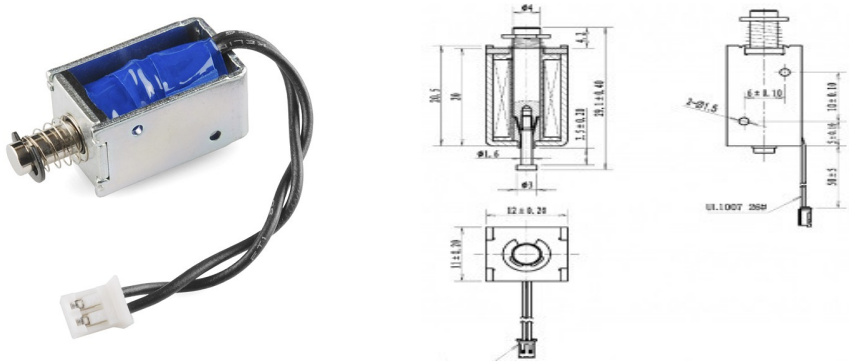
The piezo buzzer emits different sounds based on a square wave oscillation defined by a specific frequency.

The main role of this buzzer in the Day & KNight Security System:

The system activates this transducer when someone passes through the IR sensors, the reed switch is opened (window), or anytime the bluetooth module sends a request, made by the homeowner, to the microcontroller to sound the alarm.

For more information, see datasheet:
https://www.cui.com/product/resource/cst-931ap.pdf

ROB-11015 Push-Pull 5V Solenoid



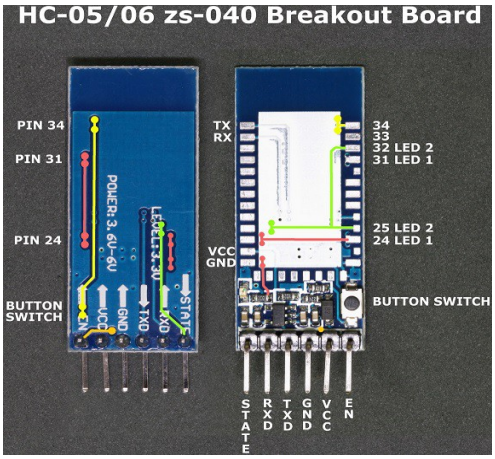
This solenoid's design allows it to work directly with 5V and makes it easy to push, pull, or controlling a switch or, in the case of this project, a door.

The main role of this solenoid in the Day & KNight Security System:

When the microcontroller receives a signal from the Bluetooth module to unlock the door, the microcontroller then transmit a signal to activate the solenoid, causing the door to open.

For more information, see datasheet:
https://cdn.sparkfun.com/datasheets/Robotics/ZHO-0420S-05A4.5%20SPECIFICATION.pdf

HC-06 ZS-040 Bluetooth Module



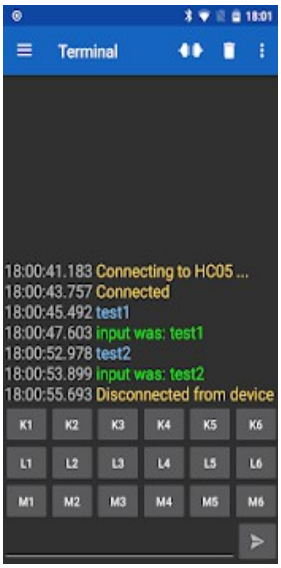
The HC-06 is designed to transmit data between a microcontroller and a Bluetooth device via a clear, wireless serial communication, where data is received in the same way it is transmitted.

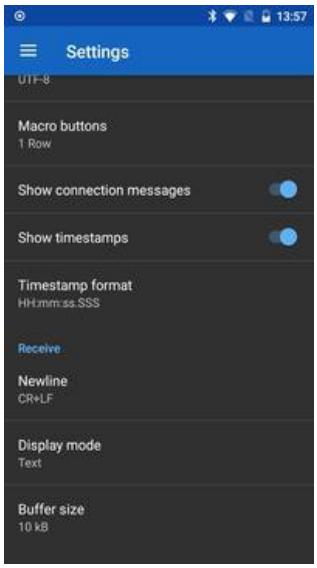
The main role of this Bluetooth module in the Day & KNight Security System:

The module communicates with the microcontroller through the UART serial communication register any Bluetooth device with the Serial Bluetooth Terminal Android application. All security notifications are transmitted from the microcontroller to the application and decisions are transmitted from the application to the microcontroller through this Bluetooth module.

For more information, see datasheet:
http://www.sgbotic.com/products/datasheets/wireless/hc06_datasheet.pdf

Serial Bluetooth Terminal Application





This Android application serves as a console for communication between a microcontroller with Bluetooth module and an Android device.

The main role of this application in the Day & KNight Security System:

This application serves to display security notifications to the homeowner and allow the homeowner to communicate decisions back to the microcontroller. Using the Serial Bluetooth Terminal, a homeowner can:

- Know how many people are currently on the property (via IR sensors)
- Know whether someone has entered or left (via IR sensors)
- Know if someone is at the door (via weight sensor)
- Know if someone opened the window (via reed switch)
- Sound the alarm
- Turn the floodlight on
- Unlock the door for 8 seconds

Diagrams

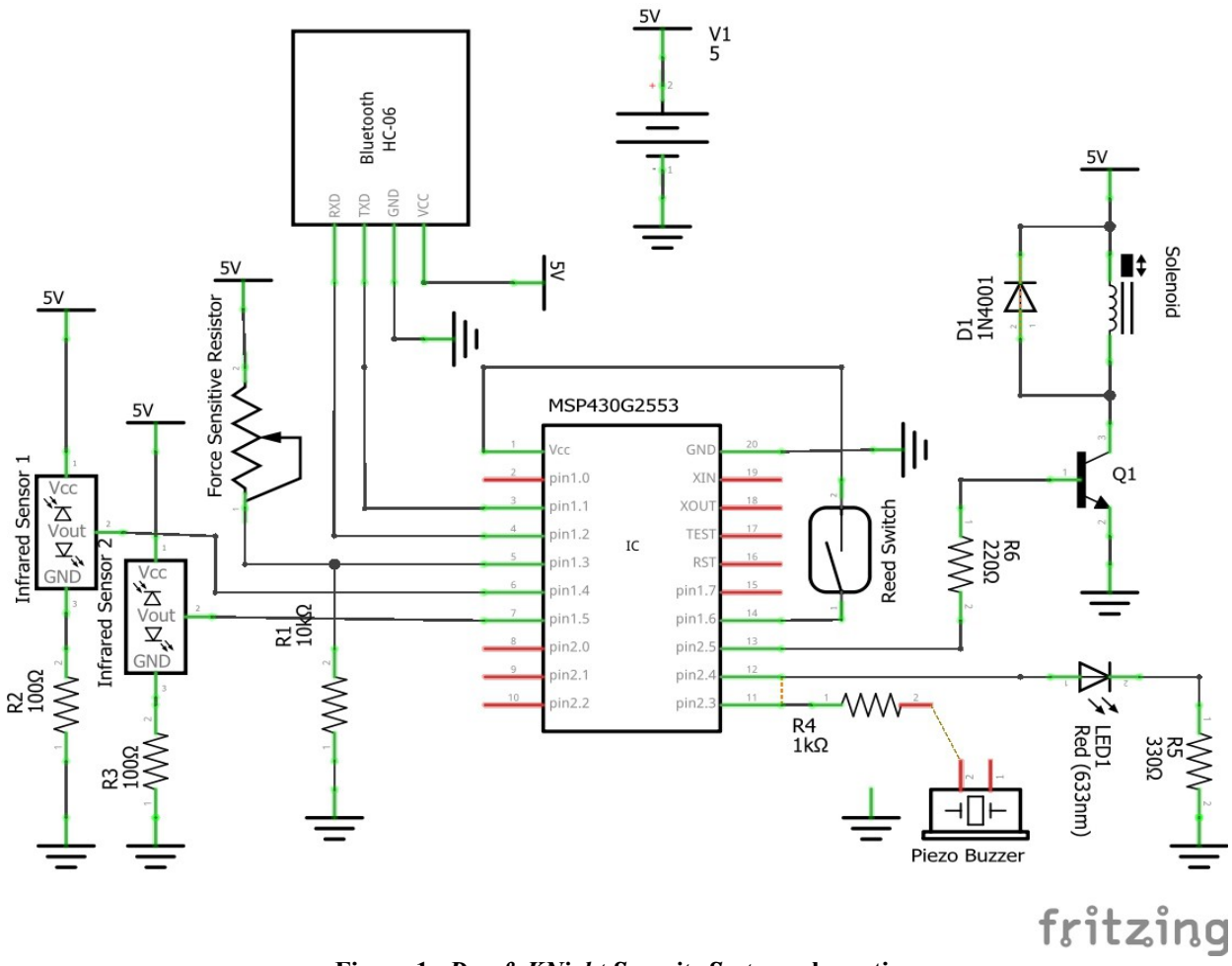


Figure 1. ***Day & KNight Security System*** **schematic**

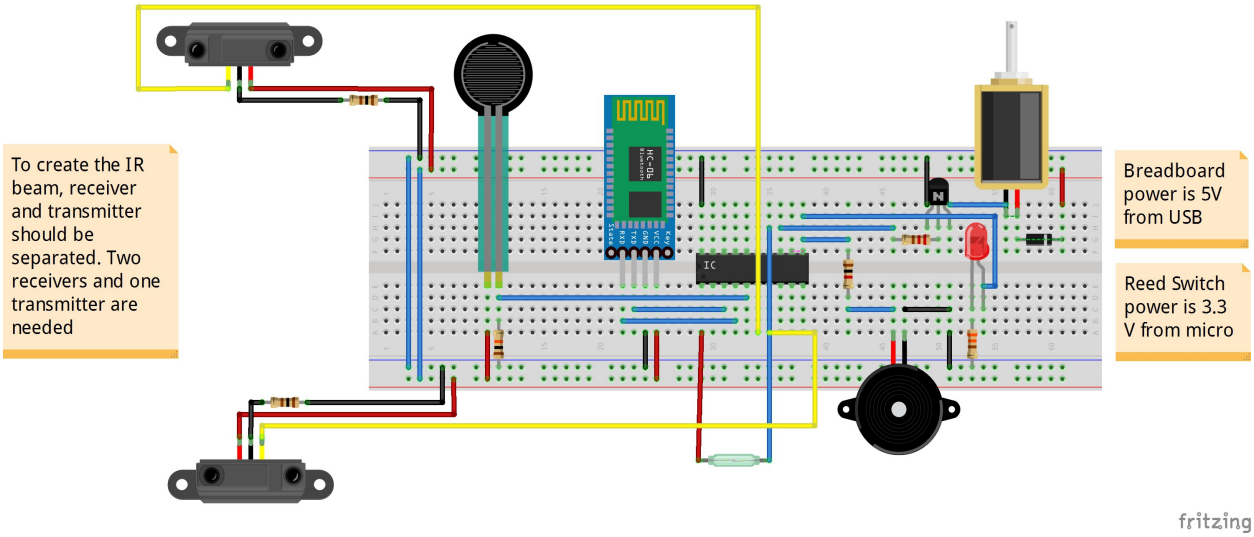


Figure 2. ***Day & KNight Security System*** **wiring**

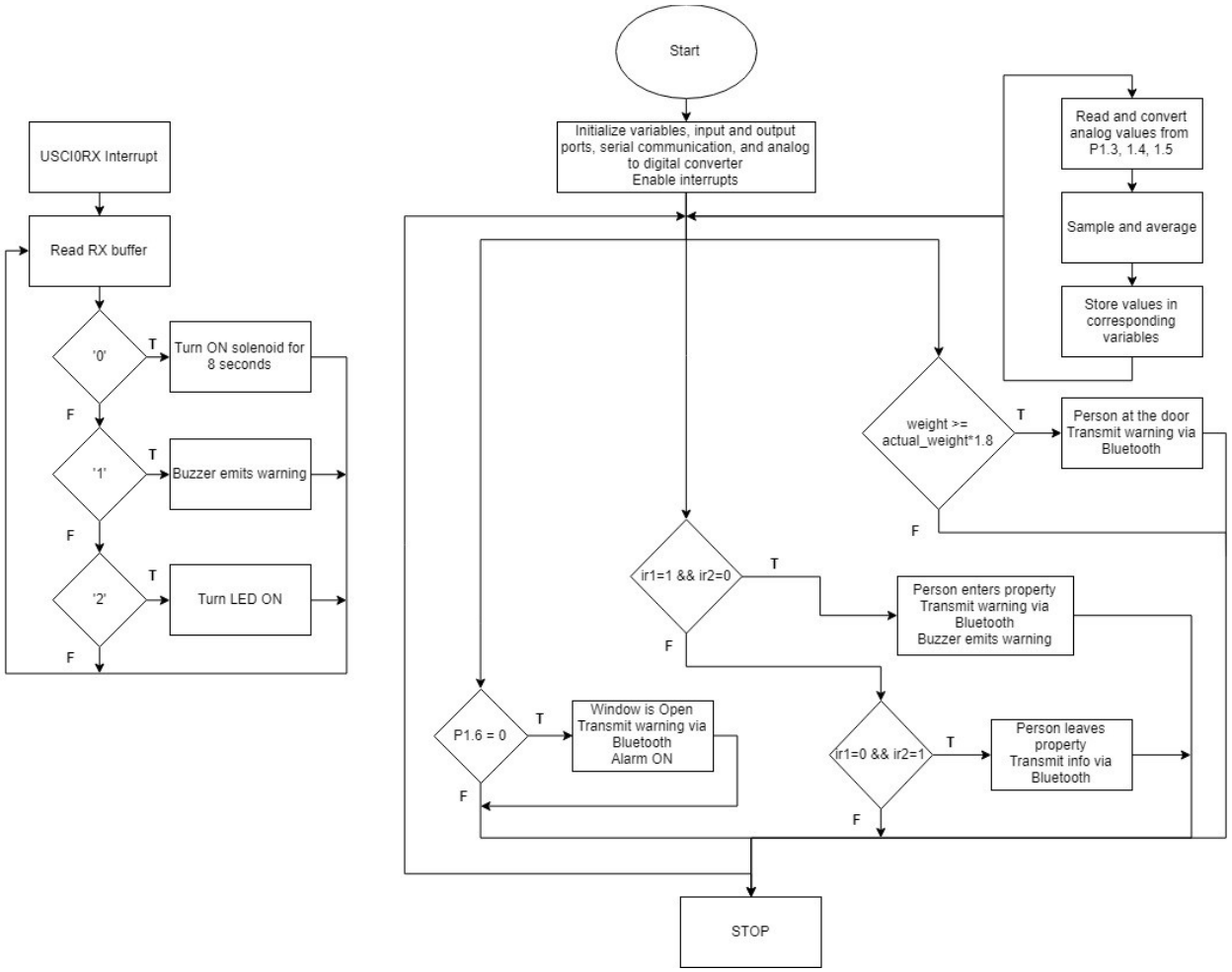


Figure 3. ***Day & KNight Security System*** **flowchart**