

ELEC2040 PROJECT

Week 4

Intruder alarm

You have the task of designing an intruder alarm, based on detecting when someone steps on a mat placed on the ground. The electronic detection circuit you need to use in the design involves charging up a capacitor which discharges into a speaker to emit an audio alarm. The characteristics of the sensor in this particular circuit means that if someone steps on the mat while running fast (ie. steps on and off again extremely quickly), then there is a 0.5 second delay until the capacitor starts charging up. When it does, you can assume this particular type of capacitor charges up to a voltage of 2V extremely fast (so fast that it can be considered negligible on the time-scale of seconds). After charging, the capacitor immediately starts discharging at an exponentially diminishing rate into the speaker (which results in the voltage diminishing over time as the capacitor discharges). The time constant of the capacitor discharging is 2 seconds.

In this part of the design, your task is to calculate how the intensity of the audio signal will vary over time, if someone stands on the mat for 4 seconds.

Make whatever assumptions about the system you need, and state them clearly. Show your reasoning and draw a plot of the voltage across the speaker as a function of time. Label the time axis in seconds, and the vertical axis in volts. Explain what is happening during time intervals of interest. Provide as much explanation as you can.

Hint: one assumption you can make to simplify this problem is to model the jolt to the system caused by someone running over the sensor as an impulse! This is probably not very realistic, but it is intended (for this question) and will make the problem much easier.