



HOME GATE AUTOMATION

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Introduction

We want to create a system to automatically open and close the main gate of the IIT Goa hostel. This will make it much easier for the security person, who currently has to manually handle a heavy gate, even in hot weather or heavy rain. The project is developing an automated gate using Arduino and an FPGA board. Automated gates have emerged as a practical solution to various challenges in property security, access control, and convenience. Our Automated gate works so that the gate will open whenever the security closes the switch. We will connect a sensor at the end of the gate so that the system can notice that the gate is opened, and the gate will remain open for a set time limit (e.g., 2 minutes), after which it'll get closed without any user input. If the user wishes to close it early, he can do it manually, too.

System Overview

The system is based on a touch sensor for input by the security person who will control the operation on the gate, which sends the signal to Arduino, which initiates a down-counter in the DE-10 Lite Board, glows LED light to show that the motor operating is going on and one signal to the motor by which we control the sliding motion of the main gate. When the down-counter reaches 0, it will send the signal to Arduino to close the main gate automatically, or if the security person touches the touch sensor before the down-counter reaches 0, the down-counter will reset, and the motor will close the gate.

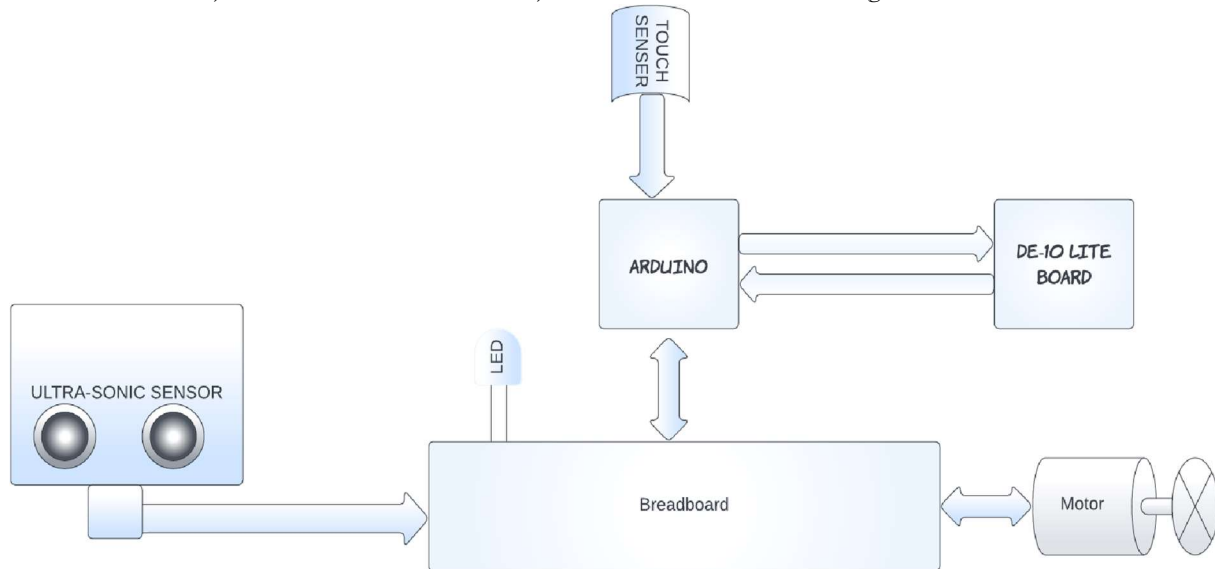


Fig. 1: Schematic of System Circuit

Implementation Details

When the user touches the touch sensor, Arduino will signal to the FPGA board, motor power supply and LED Display. The moment the motor power supply receives the signal from Arduino, it starts to open the gate by rotating. Upon receiving a call from the Arduino, the FPGA (DE10 Lite) will initiate a countdown operation using a synchronous down counter, decrementing from let's say 120 to 0. Throughout the entire process, starting from user input and continuing until the countdown reaches 0, the LED will consistently illuminate in red to indicate the ongoing operation. Upon the countdown reaching 0, the FPGA will transmit a signal to the Arduino, instructing it to initiate gate closure. Subsequently, the Arduino will send a signal to the motor power supply to close the gate, and the LED will cease displaying the red colour, indicating the completion of the process. Conversely, this sequence will be reversed for gate opening. Here we are adding the ultrasonic sensor to detect if any object comes in the path of the gate closing then Arduino will suddenly stop the motor.

Timeline

- 14/10/23: Project initiation, Research.
- 15/10/23 - 19/10/23: Component Gathering, Set up Arduino for Touch sensing and signalling the output •
20/10/23 - 21/10/23: Write VHDL code for Synchronous down counter, LED display colour and DE10 Lite board.
- 22/10/23 - 23/10/23: Establish Touch Sensor, Arduino, DE10 Lite and Motor power supply.
- 24/10/23 - 25/10/23: Develop display logic and user interface on the DE10 Lite board.
- 26/10/23 - 27/10/23: Testing, Calibration, and Safety Checks.
- 27/10/23 - 28/10/23: Interim Submission (2-page PDF, VHDL codes, and 10 min presentation).
- 29/10/23 - 08/11/23: Finalize Documentation and Report Preparation.
- 09/11/23: Final Submission (3-page PDF, submission of VHDL codes, and 10 min presentation).

Concepts Applied from the Course

- 1) Basic Logic Gates
- 2) Multiplexers
- 3) Positive Edge Triggered D-Flip Flop
- 4) Synchronous Down Counter
- 5) SEVEN SEGMENT DISPLAY

New Features & Potential Future Applications

Here are the new features and future applications in our home gate automation system, such as

- Addition of Fire alarm system
- Smartphone integration
- Biometric system addition
- Motor vehicle AI camera detection

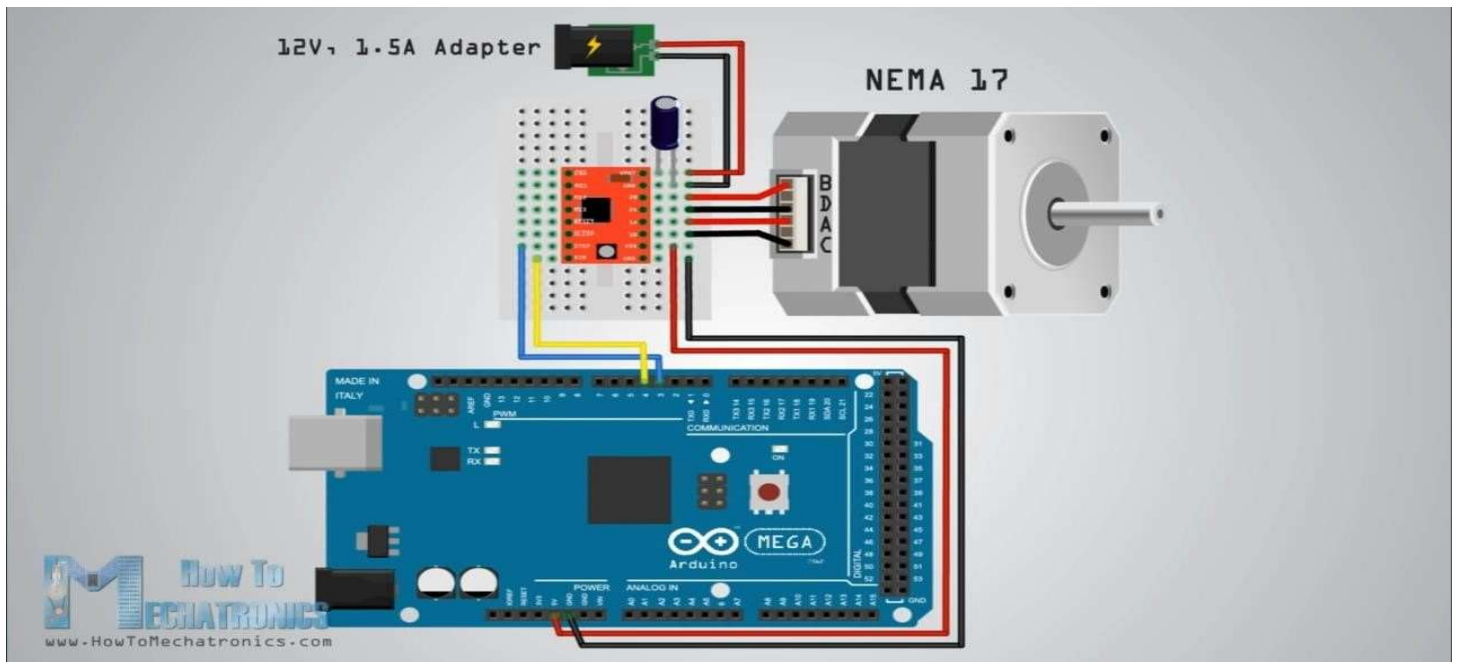


Fig. 2 Virtual circuit diagram

Contribution to Home Gate Automation Idea (Conclusion):

In this project, we try to add more functionality to the home gate automation system, such as the addition of the fire Alarm with Home Gate, which will automatically open the gate in case of a Fire emergency. Also, we can add a touch sensor, AI vehicle detection camera, smartphone integration and biometric sensors to make the home gate automation system much more advanced and flexible.

Team Contribution

Piyush & Mehak – Component Collection, designing Prototype for our project, Creating an interface between Arduino and FPGA board

Ajith – Creating VHDL Codes for Down Counter and SSD Display

Parvesh – Preparing codes for Arduino Programming

References:-

- 1) Arduino programming:- <https://youtu.be/BLrHThUjPuw?si=bhLwFbn1wkFBTeRi>
- 2) VHDL binary to BCD display:- [Convert 8bit binary number to BCD in VHDL - Stack Overflow](https://stackoverflow.com/questions/45111111/convert-8bit-binary-number-to-bcd-in-vhdl)
- 3) CIRCUIT SETUP:- <https://youtu.be/sER5GNjcQ70?si=OrcMcodc09F3NCcg>