DEVELOPMENT OF TEXTILE-BASED CAPACITIVE PROXIMITY SENSING STRUCTURES ON ROLLER BLIND FABRICS

Bayraktar O[1], **Yildirim M**[1], **Alisoy H**[2]
[1] *Research & Development Department, Zorluteks Tekstil Ticaret ve Sanayi A.S., Kirklareli, Turkey*
[2] *Department of Electronics & Communications Engineering, Namik Kemal University, Tekirdag, Turkey*
Ozge.Bayraktar@zorlu.com

EXTENDED ABSTRACT

Key Words: smart textiles, e-textiles, roller blinds

1. INTRODUCTION

Smart home systems consisting of various computing and sensing devices have attracted increasing attention. Current trends show that home security systems come first followed by comfort components like smart lighting, climate control, and entertainment in smart home technology. There is a large number of different sensing devices available such as cameras, accelerometers, GPS, acoustic systems, or capacitive sensors. Capacitive sensors use the properties of an electric field to sense presence and properties of conductive objects within range. They are commonly employed in finger-controlled touch screens that are present in billions of devices. A less common variety is the capacitive proximity sensor which can detect the presence of the human body over a distance, providing interesting applications in smart environments. The aim of the project is to develop textile-based capacitive proximity sensing structures on roller blind fabrics in order to integrate roller blinds to smart home security systems as a detector of any potential burglars breaking in through the windows and balcony/terrace doors.

2. MATERIALS AND METHODS

Potential mechanisms that can be used to detect the presence of an object are: inductive [1], optical [2], ultrasonic [3] and capacitive [4]. In this study, the capacitive sensing mechanism was preferred. It changes the capacitance due to the presence of an object. As the approaching object affects the electric field, the capacitance is changed. 100% polyester woven fabric was used as an insulator base structure for capacitive proximity sensing purpose. Metallic conductive yarns were embroidered on the insulated fabric to obtain a conductive layer. This configuration is based on the principle of a parallel plate capacitor and only requires a single conductive plate to form one electrode of the capacitor. Any potential burglars act as a virtual earth and when the burglar approaches to the proximity sensing roller blind, the capacitance between the sensing electrode and the burglar increases. The components that make up the system are (Figure 1-2):

1. Arduino UNO
2. Buzzer
3. Multiple resistors
4. Jumper cables
5. Roller blind
6. Conductive thread

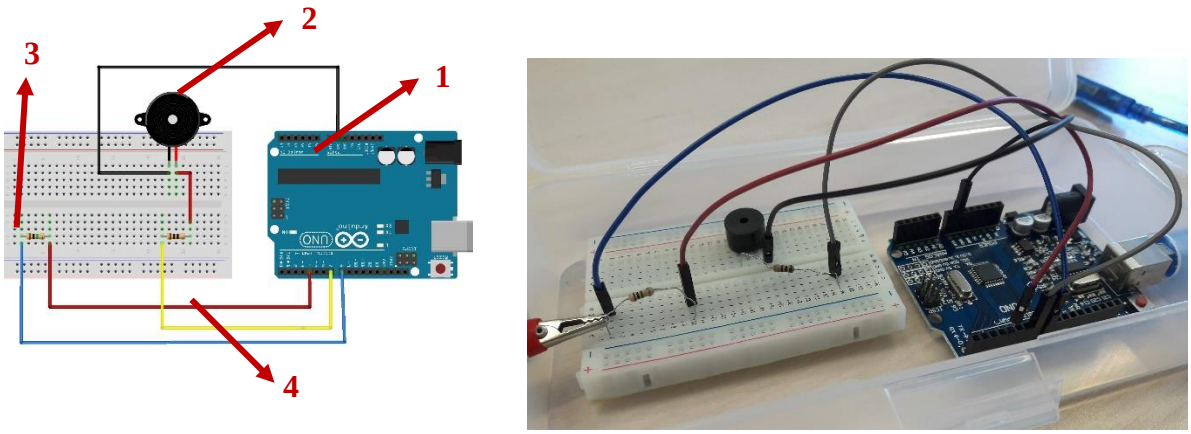

Figure 1. Electronic circuit design for the prototype

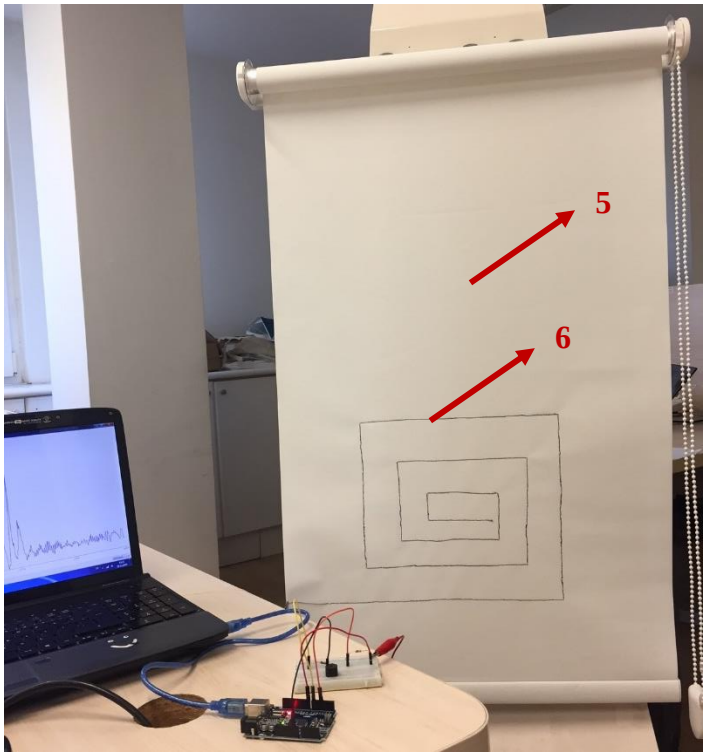

Figure 2. Textile-based capacitive proximity sensor

3. RESULTS AND DISCUSSION

The electronic circuit was designed to turn this conductive thread into a proximity sensing element. The roller blind fabric was able to detect any closing object within 15 centimetres distance (Figure 3). The performance of the sensing fabric was evaluated by using different embroidery patterns and different metallic wires in order to find the optimum parameters for capacitive proximity sensing.

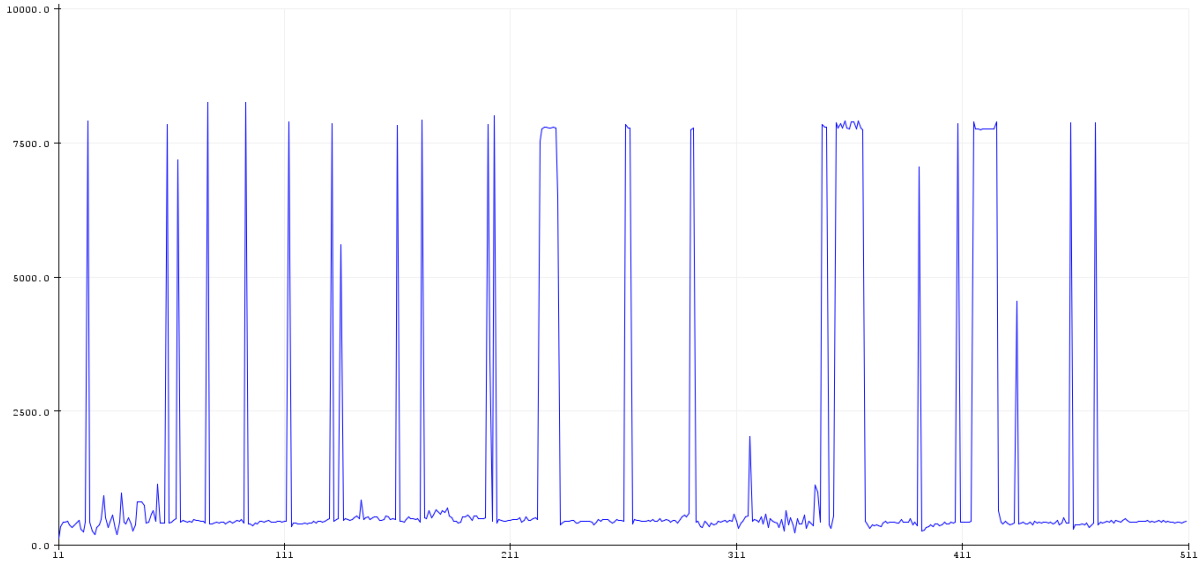

Figure 3. Capacitive proximity sensing behaviour of the fabric depending on the closing object

4. CONCLUSION

This study shows that it is possible to obtain a textile-based capacitive proximity sensing structure. Sensing structures could be used for various purposes. In this case, the sensing roller blind fabric was used as a home security system to detect potential burglars breaking in through the windows and balcony/terrace doors. In the future work, a simulation will be developed to construct a mathematical model. Additionally, real environmental conditions will be simulated.

5. REFERENCES

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