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SmaCk: Smart Knock Security Drawer Based on Knock-Pattern using Piezo-electric Effect

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ABSTRACT

In the constant advancement of technology, protection of one's property becomes a major concern for each individual. To secure one's property the protection such as locks and keys mechanism were used but this mechanism can be easily replicated. This study aims to developed a device and a security system that replaced the conventional lock and keys mechanism to secure one's property. This device also established a strong security based on the secret knock pattern security system. This security system consists of Arduino Mega, Piezo Sensor, and uses a Secret Knock that is known only to the owner. The researchers conducted hardware and system functionality. Thirty (30) trials were made in checking the accuracy of changing knock patterns where they obtained a 100% accuracy. Thirty-one (31) trials were made to check the accuracy of detecting incorrect patter. The experiments conducted obtained a 100% accuracy in detecting incorrect pattern.

Key words: arduino, knock pattern, piezo electric, security system

1.INTRODUCTION

The advancement of technology has changed the way people live, the way people interact and even the way people think, as technology progresses in the world with increasing concern for security issues day by day [1]. The traditional way of protecting one's properties is through the use of locks and keys. In modern times, it seems that keys can still be repeated because locks being innovated. To fix the duplication problems, smart home security system, wireless and automatic locks, even smart doorbells were introduced to the market. Alternatively, discarding of the physical key was done to make the lock more secure. Many studies, such as human-computer interactions, have been carried out focusing on the design of systems that allow users and machines or computers to communicate more intuitively. Technology has been developed which is a new interface between humans and computers by analyzing seismic vibration information specifically for security systems [2].

This is designed and developed in this research in the study of a fully automated feature within the digital home system. The Digital Home System was built into a variety of comput ers, i.e. Track electronic devices, web servers, remote video surveillance systems, and virtual mobile devices [3]. In the study where the researcher proposed to create an integrated Home Security System based on a microcontroller. This is where the lock is secured by the LED-based resistive screen input panel, which operates by detecting light intensity variations produced by the photodiode emitted by the round red and finger-reflected LEDs [4]. The study found that the effective use of Wireless Sensor Networks (WSNs) reduced the rate of catastrophic failures and increased the efficiency and productivity of industrial operations. Diversification of the remote-control platform is a clear trend in the production of smart appliances. This paper proposes an analysis of the remote-control system for smart devices, focused on the Zigbee wireless sensor network. The remote controller can be used to ask and check the status of home appliances. The proposed work combines the design and implementation of a modern home security system with a lightweight, self-configured remote controller based on a wireless sensor network [5]. In another research called "Energy-efficient Smart Home focused on Wireless Sensor Network utilizing LabVIEW," this house uses technology to track the environment with the aid of various sensors, monitor electrical appliances and contact the outside world. The demands for home automation increase every day. In this article, the researcher designed the design and implementation of a smart home powered by LabVIEW using a wireless sensor network. The recorded data were

immediately saved in an excel file. The app can be connected to the Internet to track home security from around the globe. [6]. A project called "Remote Home Security System Based on Wireless Sensor Network and GSM Technology" was developed in Wuhan, Hubei, where a low-energy remote home security alarm system is implemented in this paper created using WSN and GSM technology. The theft can be monitored remotely and warning notices can be sent. System software can store, accept and send data wirelessly, and can alert the consumer by transmitting a notification to the device in the form of a short message when a dangerous condition is detected. This paper offers a protection structure for ATM machines [7] In the article "Designing and implementing protection-based ATMs utilizing ARM11," no special security system for ATM machines has been in operation for a number of days. The ATM card scanner near the door is the only security system accessible to ATM centers. If one accepts and authorizes the inserted token, the door opens automatically. The study entitled "Sensor-based home automation and security system," analyzes the essence of this newly developed home control and security system based on the design and implementation of the programmable field gate array (FPGA) in the 2012 IEEE International Conference on Instrumentation and Measurement Technology (I2MTC)[8]. One can communicate directly with the system over the Internet via an Internet-based interface, while home appliances such as air conditioners, lights, door locks and gates are remotely controlled via a user-friendly website. In Rupinder Singh Brar's work, "ARDUINO uses a piezo electrical sensor focused on an industrial security device." Safety is a primary concern in our daily lives. Everyone wants to be as comfortable as possible. The access control system is a vital component of the security chain. The automated locking device described here is an access control system that allows only permitted persons to reach a restricted area. This device is suitable for corporate offices, ATMs and home security [10]. Also, in a study in which researchers established a home safety measure against leakage of gas & liquid petroleum gas (LPG). In either of the three cases, if the user is away from home, the device will send a message to the registered user. 11].

The goal of this project is to use a secret knocking pattern to create a safer and more secure box. This system consists of Arduino Super, Piezo Sensor, which uses a Secret Knock, identified only to the owner of the jewelry box. The consumer can always adjust the hidden knocking pattern by pressing the button to record the pattern to secure the computer. This sequence can be modified whenever the user wants this type of system to avoid the replication of the key to unlock the safe and deter stealing. This allows the researchers to be able to do an application for Microprocessors in this study.

This design is a challenge to create a cost-effective resolution to security without using any key to a lock system. The Piezo Sensor will be used to take analog inputs and a push button is used to allow the input to be taken. Arduino Mega will be this system's processing and control unit that collects and processes and controls data from all sensors. The sensor detects the pattern of knocking and produces pulses that the Arduino can read. From the pattern that microcontroller receives, if the pattern entered is incorrect, a buzzer will go on to alert anyone nearby.

2. TECHNICAL DESIGN

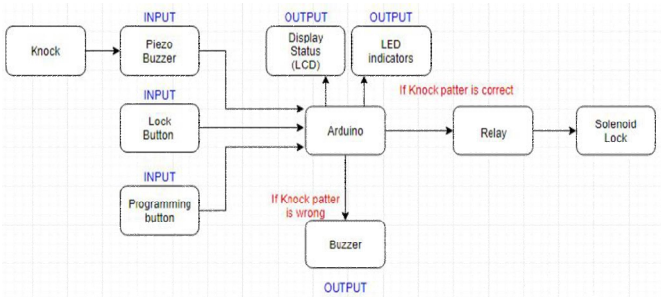

Figure 1: Block Diagram

Figure 1 displays the block diagram of the planned safety system where the piezoelectric sensor was used to sense the vibration of the knock button. When a piezo is struck, it sounds like a bell, but it provides an output voltage instead of producing a sound that generates a number based on the force applied. The voltage is then calculated in the form of numbers, and when the knocks within the specified range are counted, the Arduino records the knock as being right. When the correct voltage is detected, the servo arm is moved to unlock the box. There are two buttons on the box one will be used for recording mode and the manual mode, where the user will add the hidden knock sequence to the device that will be used to open the box and the other button will be used to manually lock the door. Two LED lights are to be used as an indication. Steady green light means the system is happy for the sequence to be reached. Blinking green light means changing the state of the locked drawer to open it. Blinking red light means that the design entered is incorrect. Clear green and red light means the system is waiting for a new pattern to be formed. Blinking green and red is the indication of a new pattern. Alternating green and red light indicates that a fresh design will be created. An Led indicator for showing the "Door Locked" or "Door Unlocked" code.

2.1 Schematic Diagram

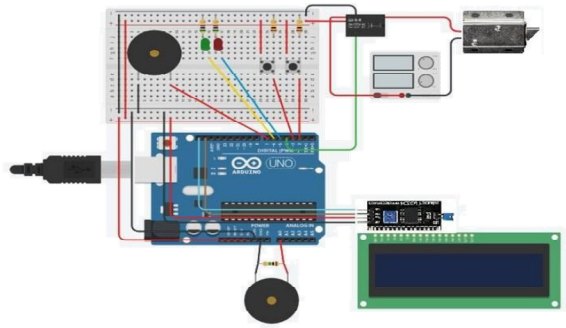

Figure 2: Schematic Diagram

Figure 3: Project Prototype

Figure 2 and Figure 3 shows the smart knock security drawer based on knock-pattern using piezo-electric effect prototype. The protype were tested from its hardware to system functionality. Hardware functionality consist of LCD to display its remarks if the device was locked, unlocked and incorrect pattern. Push buttons were also tested to verify if the beat pattern was recorded manually.

2.2 *Materials and Components*

To create the Smart Knock Security Drawer Based on Knock-Pattern using Piezo-electric Effect device, the following components were used to successfully create the proposed system

A. Arduino Mega

Arduino The Arduino UNO is a commonly distributed open-source microcontroller board built on the Microchip ATmega328P microcontroller created by Arduino.cc. In the microcontroller where all files are kept and all decisions are taken. It will decide the weather to activate alarm.
[12]. The Arduino Uno microcontroller boards come fitted with a combination of digital and analog pins that are interconnected with a number of breadboards and other circuits[13].

B. Piezoelectric Sensor

Piezoelectric sensors utilize materials that pulse under an active electrical alternating force. [14]. This device uses a piezoelectric effect to measure and monitor strain, vibration, temperature, stress or power changes.

C. LCD Display

LCD (Liquid Crystal Display) panel is an interactive display platform for a wide range of applications. LCD screens are thinner than cathode ray tube (CRT) devices. The LCD is either fitted with a passive matrix or an active lattice monitor. The passive LCD matrix has a row of pixel conductors in the box at each junction[15].

D. Solenoid

Mechanical-electronic lock system known as a solenoid bolt. Each form of lock is distinguished by the solenoid used to release the bolt. Microprocessors can use sophisticated solenoid bolt locks to control voltage, reduce power consumption and/or control input.

E. Push Button

Typically the buttons are constructed from hard material, whether plastic or metal. Most push button switches are also referred to as bias switches. Also, a bias switch can be seen as what we call a "momental switch" where the consumer has pressed "on" or "off" for example.

F. LED

LED light bulb is an electrical device for light fixtures that utilizes LED (light emitting diode) to produce light.

3. RESULTS AND DISCUSSIONS

Functionality testing were done by the researchers to verify if the proposed system performs as expected. Hardware and system testing were done as shown in Table 1.

3.1 Functionality Testing

Table 1: Dataset and Materials

No.	Testing Activities
1	The drawer is automatically locked as the system runs.
2	LCD displays "Door Locked" when user locked the drawer.
3	The default knock pattern was tested if it is working by unlocking the drawer.
4	LCD displays "Door Unlocked" when the drawer was unlocked.
5	Set new knock pattern using push-button switch dedicated for new pattern saving.
6	LCD displays "New Lock Stored" when new pattern was set.
7	The Drawer Locked when using push-button switch dedicated for locking the drawer.
8	The system detects incorrect knock pattern when input an incorrect knock pattern.
9	The LCD Displays "Incorrect Knock" when incorrect knock pattern was entered
10	When new knock pattern was entered the system works.
11	The LCD Displays "Door Unlocked" when entered the new knock pattern to unlocked the drawer

3.2 Changing of Knock Pattern

Table 2: Dataset and Materials

CHANGING OF KNOCK PATTERN							
TRIAL NO.	STORED BEAT PATTERN	PATTERNS FOR TESTING			EXPECTED OUTPUT	ACTUAL OUTPUT	RESULT
		BEAT PATTERN 1 [Row, Row, Row Your Boat]	BEAT PATTERN 2 [Happy Birthday]	BEAT PATTERN 3 [Jumbo Hotdog]			
1	BEAT PATTERN 1	✔			BEAT PATTERN 1	BEAT PATTERN 1	SUCCESS
2	BEAT PATTERN 2		✔		BEAT PATTERN 2	BEAT PATTERN 2	SUCCESS
3	BEAT PATTERN 3			✔	BEAT PATTERN 3	BEAT PATTERN 3	SUCCESS
4	BEAT PATTERN 1	✔			BEAT PATTERN 1	BEAT PATTERN 1	SUCCESS
5	BEAT PATTERN 2		✔		BEAT PATTERN 2	BEAT PATTERN 2	SUCCESS
6	BEAT PATTERN 3			✔	BEAT PATTERN 3	BEAT PATTERN 3	SUCCESS
7	BEAT PATTERN 1	✔			BEAT PATTERN 1	BEAT PATTERN 1	SUCCESS
8	BEAT PATTERN 2		✔		BEAT PATTERN 2	BEAT PATTERN 2	SUCCESS
9	BEAT PATTERN 3			✔	BEAT PATTERN 3	BEAT PATTERN 3	SUCCESS
10	BEAT PATTERN 1	✔			BEAT PATTERN 1	BEAT PATTERN 1	SUCCESS
11	BEAT PATTERN 2		✔		BEAT PATTERN 2	BEAT PATTERN 2	SUCCESS
12	BEAT PATTERN 3			✔	BEAT PATTERN 3	BEAT PATTERN 3	SUCCESS
13	BEAT PATTERN 1	✔			BEAT PATTERN 1	BEAT PATTERN 1	SUCCESS
14	BEAT PATTERN 2		✔		BEAT PATTERN 2	BEAT PATTERN 2	SUCCESS
15	BEAT PATTERN 3			✔	BEAT PATTERN 3	BEAT PATTERN 3	SUCCESS
16	BEAT PATTERN 1	✔			BEAT PATTERN 1	BEAT PATTERN 1	SUCCESS
17	BEAT PATTERN 2		✔		BEAT PATTERN 2	BEAT PATTERN 2	SUCCESS
18	BEAT PATTERN 3			✔	BEAT PATTERN 3	BEAT PATTERN 3	SUCCESS
19	BEAT PATTERN 1	✔			BEAT PATTERN 1	BEAT PATTERN 1	SUCCESS
20	BEAT PATTERN 2		✔		BEAT PATTERN 2	BEAT PATTERN 2	SUCCESS
21	BEAT PATTERN 3			✔	BEAT PATTERN 3	BEAT PATTERN 3	SUCCESS
22	BEAT PATTERN 1	✔			BEAT PATTERN 1	BEAT PATTERN 1	SUCCESS
23	BEAT PATTERN 2		✔		BEAT PATTERN 2	BEAT PATTERN 2	SUCCESS
24	BEAT PATTERN 3			✔	BEAT PATTERN 3	BEAT PATTERN 3	SUCCESS
25	BEAT PATTERN 1	✔			BEAT PATTERN 1	BEAT PATTERN 1	SUCCESS
26	BEAT PATTERN 2		✔		BEAT PATTERN 2	BEAT PATTERN 2	SUCCESS
27	BEAT PATTERN 3			✔	BEAT PATTERN 3	BEAT PATTERN 3	SUCCESS
28	BEAT PATTERN 1	✔			BEAT PATTERN 1	BEAT PATTERN 1	SUCCESS
29	BEAT PATTERN 2		✔		BEAT PATTERN 2	BEAT PATTERN 2	SUCCESS
30	BEAT PATTERN 3			✔	BEAT PATTERN 3	BEAT PATTERN 3	SUCCESS

Table 2 shows the changing knock pattern results where there were 30 trials that have been made. There were three beat patterns that were stored in the device. Each stored beat pattern has designated activities to perform such as unlocking and locking the drawer. For each trial, actual output was compared to the expected output which is the same beat with the stored beat pattern. When the actual output is same with the expected output this results to success as indicated in the remarks in the table 2. Based on the trials conducted the system has almost 100% accuracy.

3.3 Changing of Knock Pattern

Table 3: Incorrect Pattern Testing Results

TESTING OF INCORRECT PATTERN				
Trial	Pattern Input	Prototype Response	Correct Pattern	Result
0	"Row, Row ,Row Your Boat Gently Down The Stream"	Door Unlocked	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
1	1 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
2	2 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
3	3 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
4	4 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
5	5 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
6	6 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
7	7 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
8	8 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
9	9 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
10	10 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
11	11 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
12	12 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
13	13 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
14	14 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
15	15 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
16	16 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
17	17 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
18	18 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
19	19 taps	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
20	"Happy Birthday to You"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
21	"Jumbo Hotdog Kaya mo ba to"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
22	"Kaya mo ba to"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
23	"Hindi kami bato para magpatalo"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
24	"Di na mababawi"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
25	"Iniwang sakit"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
26	"Sa mga salitang binitiwan mo"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
27	"Hindi bat ikaw na rin ang nagpasya"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
28	"Nagtakda at syang unang umiwas"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
29	"Bakit nga ba akoy yong pinaasa"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
30	"Mahal kita maging sino ka man"	Incorrect Pattern	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS
31	"Row, Row ,Row Your Boat Gently Down The Stream"	Door Unlocked	"Row, Row ,Row Your Boat Gently Down The Stream"	SUCCESS

Table 3 shows the incorrect pattern results on the testing that have been made. Thirty-one (31) trials have been tested, in every beat pattern there was a corresponding activity that the prototype performed. For every incorrect beat pattern made it displayed an "incorrect pattern" label in the LCD. For thirty-one trials that intentionally input an incorrect pattern it displayed "incorrect pattern" in the LCD for thirty-one times. As a result, in the experiment made it shows that 100% accuracy of detecting "incorrect pattern" for each trial that wrong pattern was entered.

4. CONCLUSION AND FUTURE WORKS

In the advent of advance technology, the issues on crimes and thieves were many times tried to solved by technology but still the issue on security were not yet solved. Thus, the smart knock security drawer based on knock pattern using piezo electric becomes significant to those who used this device to aid the security issues of using conventional locks and keys. To ensure the functionality of the device and its system, functionality testing was done. Based on the functionality testing conducted as shown in Table 1-3 where knock pattern resulted into 100% success rate in functionality and system testing. This device can be improved by interfacing several technologies such as voice recognition, biometrics and others to make the drawer more secure.

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