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Designing a Prototype for Face Recognition based Smart Locker System

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Abstract

Everyone is concerned about the safety of their things in public places in recent days. In this circumstance, ensuring the security of the items should be taken into consideration. Moreover, in today's world, disinfecting in more important as it is a critical part of the user's experience to provide a sense of security and comfort. Therefore, this study is focused on smart locker, which is sustainable alternative solution for security systems with practically touch less experience. The main objective of this paper is focused on develop a prototype for smart locker system and test the system under controlled environment. It is a simpler version of security systems than that are already available in the market using face recognition, which can be used in public places. Arduino based data acquisition system and Python based programming system were used to implement this security system. In order to use this locker, users must face the camera to register them on the system and allocate a cell for their goods. Users need to face the camera again to confirm their identity to unlock the cell when they need to get their goods back. We carried out a comparison on random faces collected from internet to analyze using face recognition and the experimental results show that the study archives better results over existing works.

Keywords: Smart locker; Face recognition; Safety locker; Smart security system; Internet of Things.

1. Introduction

Existing security systems in shops and public places are using a cell system to store their goods, and are handled by a security officer in developing countries like Sri Lanka. This system uses a token to confirm the identity. In such cases, people can lose their tokens or token can be infected during this critical pandemic situation. It leads to lose the ability to prove their ownership and also leads to spread the infectious disease like coronavirus from person to person. Therefore, design a smart locker system to avoid these problems and without human intervention is needed. Several kinds of smart security systems were developed during past years [1].

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But those are targeting high level security and most are very complex to use and especially expensive. The main objective of this study is to develop a prototype for smart locker system and test the system under controlled environment. This system uses bio metric data to identify the respective person using face recognition method. This study is a part of the project which focused on development of low cost IoT based smart system using face recognition technologies.

2. Methodology

The system consists of two main parts, such as (i) Data acquisition hardware, (ii) Programming system. Arduino Uno, three different Light Emitting Diodes (LEDs) (Green, Red, Yellow) and four push buttons were mainly used to develop the prototype. Initially prototype was developed only for the one cell of the locker system. Red, Green, and Yellow LEDs were used to represent locker reserved by someone, locker is available for placing goods, and the function of electric solenoid lock, respectively. Push buttons 1, 2, 3, and 4 were acted as cell selection button, capturing button, unlock button, and program termination button, respectively. Push buttons, LEDs, and Solenoid lock were controlled by Arduino. Laptop was connected with prototype as an information processing unit. Web cam of the lab top was used to collect the biometric data and collected data were used for the image processing analysis. Python was used as a main programming language of this system and Firmata library [5] was used to build the connection between python and Arduino Uno. Web cam and Arduino were directly controlled by Python commands. It is controlled more than one cell with one camera and one raspberry pi module. Therefore, software and hardware parts should be further modified when increasing the number of cells. But, increasing the cells will be affected to the speed of the program and when one module has more cells to handle, there might be a queue in cells. Therefore, our recommended numbers of cells are five for one module. Schematic diagram of proposed system and the view of mart locker system are given in Figure 1 and Figure 2, respectively.

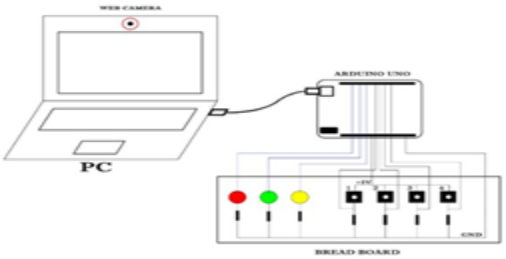

Figure 1: Connection of the components.

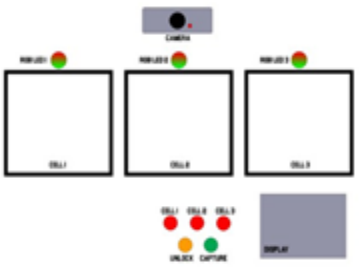

Figure 2: Overall view of the smart locker system.

3. Results and discussion

When the cell button was pressed, camera was turned on and after the pressing of capture button, Red LED was ON and Green LED was turned OFF. It indicates the cell was reserved and also Yellow LED was turned ON for 10 Seconds. All captured images were stored in the computer storage. Next unlock button was pressed. Again web cam was turned ON. After that Yellow LED was on for 10 seconds, then Green LED was turned ON and the Red LED was turned OFF. It indicates that cell is available for another user. To validate the proposed system, around four random faces with four different moods were used to validate the system's detection efficiency. System was unlocked for same person with different moods 100 % accurately and for different persons 0%. More real samples cannot be able to collect within the time frame due to this pandemic situation. Therefore, validating the system with more samples and multiple cells are ongoing at present.

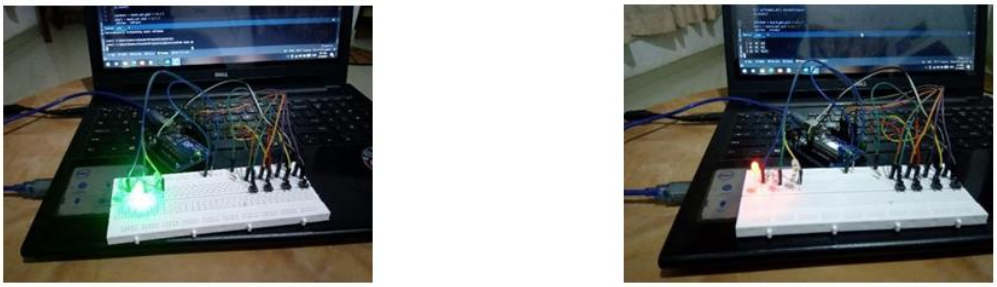

Figure 3: Experimental stage.

4. Conclusions

The main features of the system are face recognition part and communication part between the Arduino board and python program. The previous studies conducted on smart locker systems are high level and expensive when compared to this study. This is a fully offline automated system. So, there is no chance to hack this system remotely. Through this paper we highlight the designing of a prototype for the automatic locker system and analysis of random faces from the internet. The corresponding real face analysis with different moods is on-going at present.

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