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Motion Detection System with Mobile Application for Notification

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Abstract. Maintaining your home's security is crucial, especially when you are away. Home security must be managed with a tool in order to guarantee that security is constantly awake. In other words, a smartphone today is a tool that is frequently taken everywhere. Therefore, the movement detector makes use of a smartphone technique so that consumers can be more cautious when away from home. Using the Raspberry Pi Model B V1.2 and camera Pi in this system, users may monitor the situation at home in a safer manner using a smartphone thanks to the IoT or Internet of Things. This system was designed using a prototyping system process so that each prototype may be enhanced to meet the goal. Therefore, by seeing photos that have been shot after motion has been detected using a Passive Infrared Sensor (PIR) combined with the Raspberry Pi board, the application system will help the user boost security at home.

Keywords: Detector, mobile application, motion detection system.

INTRODUCTION

The level of technology in use today is constantly rising. In all nations around the world, crimes do happen. Many video recording systems, or closed circuit television (CCTV), have been developed in order to keep monitoring order to prevent crimes in public places, private residences, and business locations. Closed-circuit television (CCTV) is a tool that records video from specific locations so that it may monitor the neighborhood [1]. A German business created the first CCTV in 1942 to watch V-2 rocket launches. Digital video recorders (DVRs), cameras, and monitors make up the majority of CCTV systems.

The usage of CCTV in public spaces, schools, residences, towns, and on roads has increased significantly in the US [2]. An average of 70 times a day are captured by cameras in the Brighton area, according to a prior study, which estimates that there are already nearly 1.85 million CCTVs in use in public spaces throughout the United Kingdom [2]. Closed-circuit television (CCTV) is unquestionably present in every business location in Malaysia to deter burglaries and robberies [3]. Their commercial space is kept safer thanks to it. In Malaysia, CCTV is widely employed to manage security, and even when someone is murdered, this system is also in place. One of the crucial functions in managing the finest security is the position of the CCTV [4]. An ineffective location makes the CCTV less effective in capturing the surroundings.

Therefore, the "Motion Detector with Mobile Application for Notification " system was created to assist business property owners and homeowners in using the IoT idea to improve security control in their locations. Users of this project can use a smartphone to

position it in an appropriate location to further boost security against invaders. If the user doesn't have a house or business location, it can still enhance the security system in order to make it better.

LITERATURE REVIEW

Systems for creating applications are created using Android Studio. Kotlin, which is more structured, is the programming language used. Android Studio is only able to create apps that are Android-based.

In addition to the proposed system, three existing systems were chosen to be examined in greater detail. There are currently three systems available: the Home security PIR mp alert infrared sensor [5], PIR alarm motion sensor Wi-Fi hidden camera [6], and Motion detector hidden camera [7]. Table 1 compares the proposed system to the existing system based on the case study to highlight the differences.

TABLE 1. Comparison of the current and proposed systems

System / features	Home Security PIR MP Alert Infrared Sensor	PIR Alarm Motion Sensor Wi-Fi Hidden Camera	Motion Detector Hidden Camera	Proposed System
Mobile Apps	None	None	None	Yes
Registration	None	None	None	Yes
Login	None	None	None	Yes
Storage	Micro SD	Micro SD	Micro SD	Cloud
Notification	None	None	None	Yes – smart phone
Internet connection	No	Yes	No	Yes
Time/Date	No	Yes	Yes	Yes
Take a picture	No pictures are captured just motion detection	Take pictures after detecting movement	No pictures are captured just motion detection	Take pictures after detecting movement
Emergency call	No	No	No	Have an emergency call button

Table 1 shows that none of the three current systems employ mobile applications to communicate with motion detectors. In contrast to the suggested application system, check-in, log-in, and log-out are all available. Additionally, none of the three current systems use notifications on the mobile application and all storage is micro SD. The PIR alarm motion sensor Wi-Fi concealed camera also needs an internet connection to function properly.

The only infrared sensor and PIR mp alert system for home security that lacks a date and time display is that one. The benefit of the suggested method is using a mobile app to determine whether the passive infrared sensor (PIR) detects movement. The system is suggested to use cloud storage to store photographs that are captured as well as time and date. Last but not least, the suggested system contains an emergency call feature that allows the user to speak with authorities immediately. The user can also decide whether to activate the system or not.

METHODOLOGY

The system prototype model used to create this suggested system is a software model. The planning, analysis, design, implementation, and prototype system phases make up this prototype system model [8]. This approach was chosen since it allows for the speedy development of the suggested system in order to gather user feedback and meet user needs. According to Table 2, there are tasks and outputs that must be created during each phase of the project development process.

TABLE 2. System Development Workflow

Phases	Task	Output
Planning	• Title options • Identifying problems • Determine objectives and scope • Make a study of the existing system	• Proposal • Gantt chart • Literature Review
Analysis	• Analyse the differences between existing systems • Identify the software and hardware to be used • Identify user needs	• Software and hardware requirements • Functional requirements • Need not work • Use case diagram • Activity diagram • Sequence diagram
Design	• Design a prototype application Database design • Circuit design	• Diagram of the prototype application interface • A diagram of the circuit layout
Implementation	• Codes on the Raspberry Pi • Programming the application	• Android Things operating system • The interface of mobile application
Prototype system	• Build application interface • Build a circuit prototype - camera and motion detector	• The prototype works well • Improvements to the prototype
System	• Testing the final system	• The motion detection system with notifications through the mobile application is fully functional

The activity diagram tries to provide users with a high-level picture of the journey or process so they can utilize this system fully. Figure 1 depicts how the user will initially see the login screen. Users have the option to display a lost password or continue logging in. Users can update their password using a link that will be delivered by Gmail utilizing the forgot password display. Those who successfully access the main menu display have a variety of options.

Multiple users can be registered using their email and password utilizing the login view. For users to change their passwords to new, more secure ones, there is a password change display. Pictures taken by the camera that have been uploaded to cloud storage are shown in the main menu. The user can simultaneously hit the emergency button, which will take them immediately to the calling screen depending on the model of smartphone they are using. To log out, a user must tap the log out button, which takes them to the smartphone's main menu.

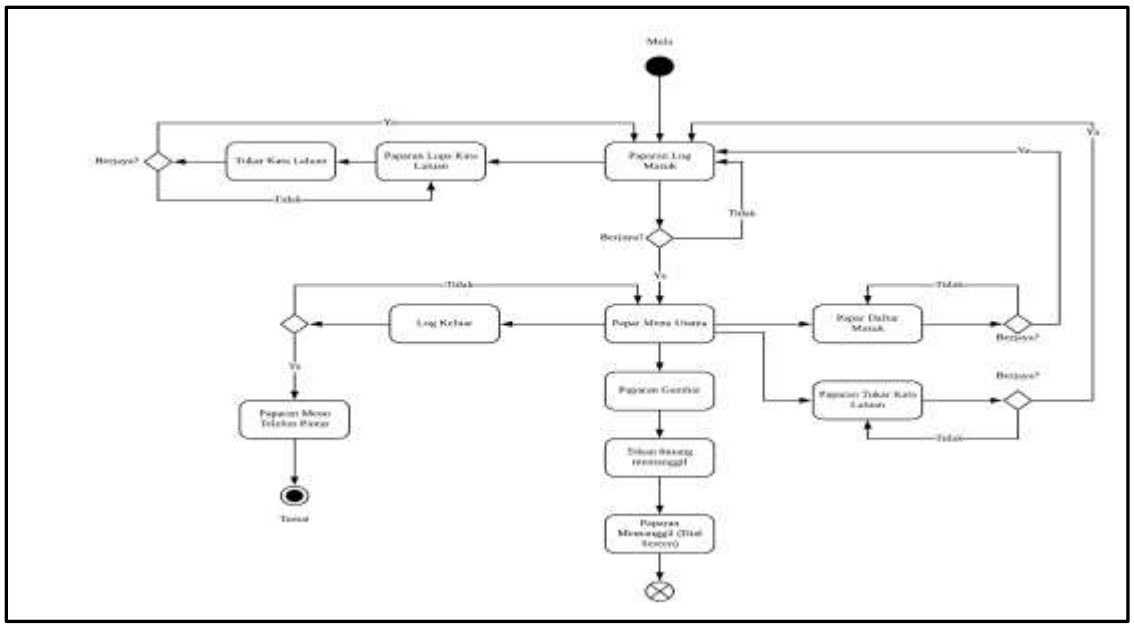

FIGURE 1. Activity Diagram for Proposed System

IMPEMENTATION

Technology from Android Studio and Google Firebase is used in the suggested application system. User information and images captured by the Pi camera are stored in Google Firebase. The interface for the suggested mobile application is being created using Android Studio.

Pi cameras and passive infrared sensors are the primary elements of this Internet of Things setup (PIR). If the Pi camera detects movement in front, the Passive Infrared Sensor (PIR) will start taking photographs. Prior to sending the image to the mobile application, the image will first be saved in Google Firebase. LED lights are also utilized to check the functionality of the motion detector. The IoT component prototype for the suggested application system is shown in Figure 2.

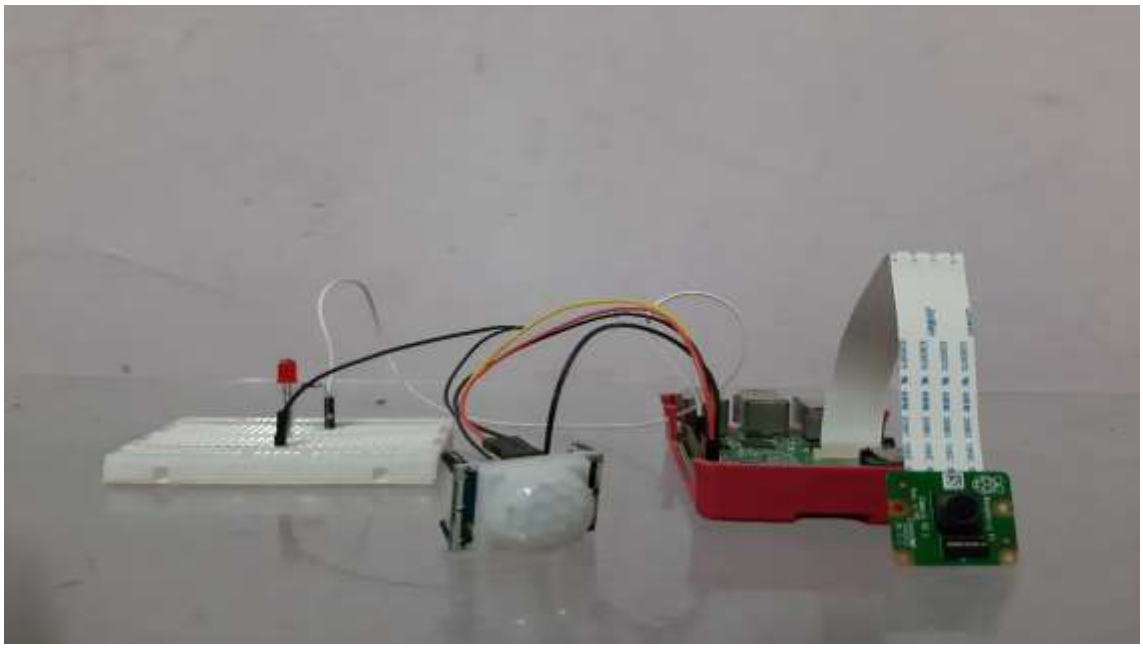

FIGURE 2. Prototype IoT Component

An application for a mobile device's UI is crucial for user convenience. After logging in, the user sees the program interface in Figure 3. The system activation layout, which is at the top of the main menu, is shown in the first image. The option of "system on" or "system off" is available to users. Because it is one of the components linked to the actual database, if the user chooses "system off," this application won't show the image identified by the motion detector.

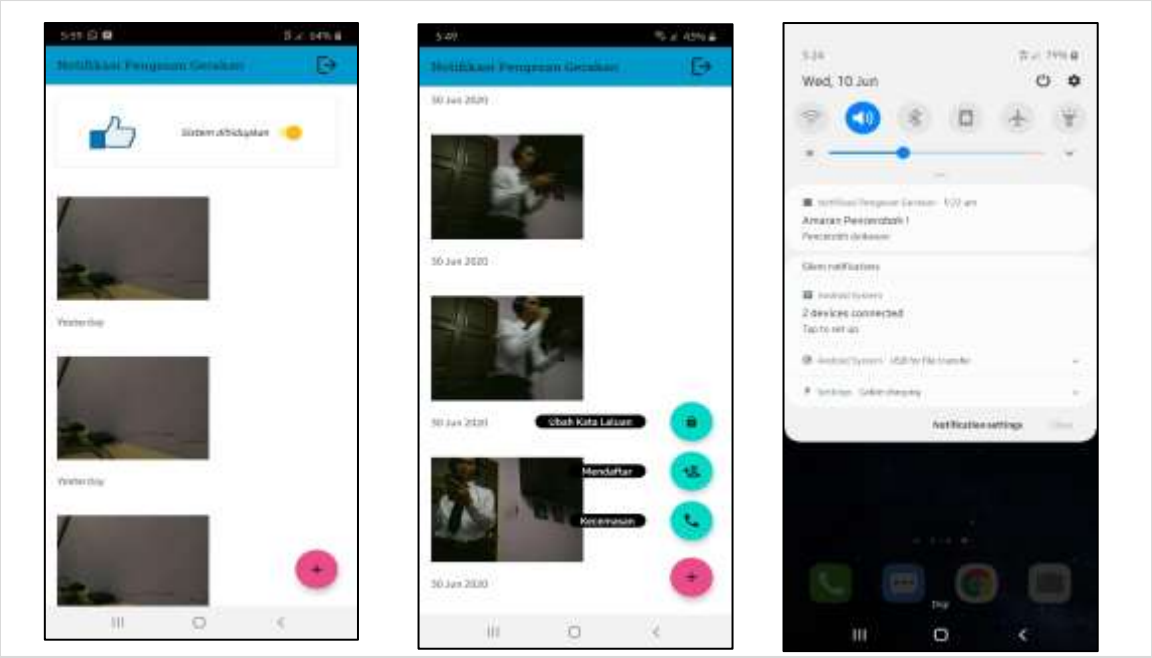

FIGURE 3. The Proposed System's Interface

The image and the date of capture are displayed on the main menu interface. The time will update to the date if the image is present in the program for an extended period of time. A button to call the police in an emergency, a button to register new users, and a button to alter an existing user's password are among the other buttons. A button to log out of the application is located at the top of the main menu. The design of the notification that the user will see in the third image if the motion detector picks up any movement is shown.

The functional requirements or system specifications for each component and module in this project are required to be verified through functional testing. The Raspberry Pi board, database, motion detector, camera, and system interface are all being tested during this phase.

CONCLUSION

In conclusion, an Internet of Things-based technology can raise the bar for home security. The cameras and motion detectors in this system are crucial. Additionally, after being able to detect movement, the mobile application also contributes to users being able to view the photographs that were shot. On the mobile application, users can always activate or deactivate this system. The system can modify the date display in the future to make it more user-friendly rather than merely showing the date for images preserved for longer than two days. The system has the option of including a filter feature for date-based image searches.

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