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Implementation of Charity Box Security System Based on Internet of Things (IoT) Using Sensors and Notifications

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***Abstract*— Mosques are places of worship for Muslims. With a large number of mosques, the problems that arise are also diverse, for example the AL Akbar Surabaya mosque has 2 thefts per year. The form of breaking into the charity box was in the form of the destruction of the padlock hinge made of iron plates in the outer courtyard of the mosque. This is a problem for mosque managers. The purpose of this research is to create a security system for the charity box of the Al Akbar National Mosque that can be controlled remotely using the Internet of Things (IoT). This system will ensure the safety of the charity box and prevent the possibility of theft or manipulation of the money contained in it. This security system uses motion sensors as an indicator of suspicious activity around the charity box. When the vibration sensor detects vibration, the system will activate the Buzzer and the ESP32 CAM camera takes pictures to be further processed using a face detection algorithm and the results are sent in the form of a notification to the mosque manager who is connected to the internet network, so that it can take photos that can be accessed in real-time by security control. To control this security system, a mobile application will be built that can be accessed by mosque administrators. Overall, this design will provide a higher level of security for the Al Akbar National Mosque charity box. With a security system that can be accessed and controlled remotely through IoT. The mosque management can quickly respond and take action in unsafe situations.**

Keywords*— *charity box, esp32, IoT, vibration sensor, buzzer, camera

I. INTRODUCTION

Mosques serve not only as places of worship but also as centers of community activity, often receiving voluntary donations through charity boxes (kotak amal) to support operational and social programs. However, the increasing number of reported theft cases from these boxes, such as the repeated incidents at Al Akbar National Mosque in Surabaya, underscores the pressing need for enhanced security measures. Conventional locking mechanisms are no longer sufficient, as they are vulnerable to physical tampering and forced entry [1]. The emergence of the Internet of Things (IoT) provides new opportunities to address such security concerns by enabling real-time monitoring, remote control, and data-driven responses [2], [3]. IoT-based systems have been successfully implemented in various sectors including home security [4], smart agriculture [5], industrial monitoring [6], and health systems [7]. These systems typically integrate sensors, microcontrollers, and wireless communication to provide efficient, autonomous, and real-time surveillance and alerts [8]. This research proposes the implementation of an IoT-based security system for mosque charity boxes, particularly at the Al Akbar National Mosque. The system integrates a vibration sensor to detect unauthorized physical access, and an ESP32-CAM microcontroller equipped with a camera module to capture real-time images. Detected activities trigger alerts through a buzzer and initiate image capture for facial recognition processing. The resulting data is sent to the mosque management via the internet, enabling real-time notifications and monitoring through a mobile application [9], [10]. Similar implementations have demonstrated success in reducing theft and unauthorized access in other domains [11], [12]. The use of motion and vibration sensors combined with visual evidence has proven to increase response efficiency and reduce false alarms [13]. Moreover, cloud-connected systems allow for remote storage and access of data, ensuring that security alerts are not confined to local monitoring only [14]. This study aims to design, develop, and test a functional prototype of a smart charity box security system, contributing to the growing field of IoT security applications in religious and public institutions. The successful deployment of this system is expected to enhance the overall safety and trust in public donation mechanisms [15].

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II. RESEARCH METHODS

A. *Product Design*

Product sampling is a procedure that must be followed to conduct product research and ensure that the final product meets the requirements to be researched by the researcher. In this writing, the researcher describes design drawings, block diagrams, and tool assembly

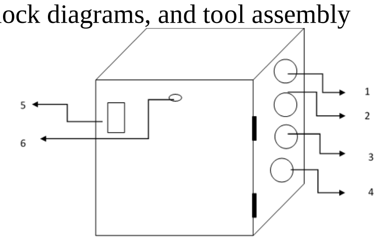

Fig. 1. Design Product

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Product Design Pictures Explanation:

1. NodeMCU
2. Vibration sensor SW 420
3. Buzzer
4. Module UPS DC Power
5. RFID
6. Camera

B. Block Diagram

This IoT-based charity box security system operates by utilizing the SW 420 vibration sensor to detect suspicious activities such as shaking or tampering. When the sensor detects vibrations, it sends a signal to the NodeMCU, which functions as the central controller. The NodeMCU then activates a buzzer as a sound alarm, powers on the camera through a 5V relay, and sends a command to the ESP32 to capture an image of the situation. The ESP32-CAM camera takes a photo and sends it to the Telegram application connected to the mosque administrators, allowing them to respond quickly. The system is also equipped with an RFID module to differentiate authorized access by staff and a UPS as a backup power source to keep the system running during power outages. With internet connectivity, the entire system can be monitored and controlled in real-time via a mobile application, significantly enhancing the security of the charity box.

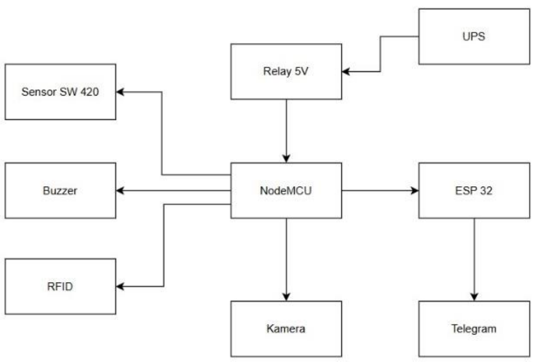

Fig. 2. Block Diagram System

The microcontroller will connect to Telegram, if it is not connected, then the microcontroller will continue to connect to Telegram, and if it is connected, the microcontroller will analyze the system and analyze the face detector, after that the SW 420 sensor will read the vibration, if it detects an object, the microcontroller will send a photo notification to Telegram, and if it is not detected face, then the microcontroller will send a notification to Telegram.

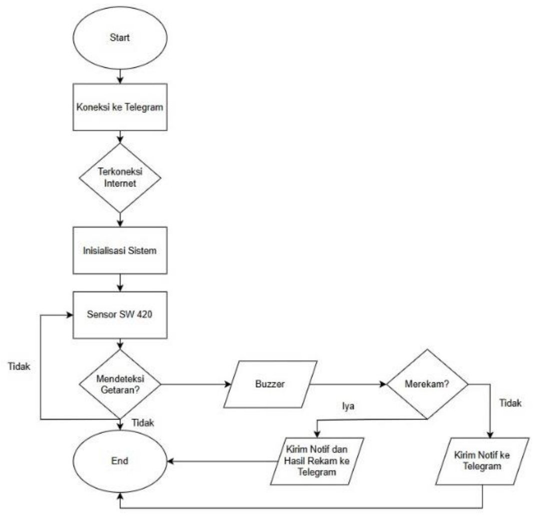

Fig. 3. Flowchart Charity Box

C. Wiring Diagram

The system in the picture consists of several integrated components, each serving a specific function. The Arduino serves as the central control system or "brain" that manages all processes. The ESP32 module functions as a communication and control interface, while the SW 420 vibration sensor acts as the primary input device for detecting vibrations caused by forced movements. Once vibrations are detected, the Arduino processes this data and sends a signal through the ESP32 module. A buzzer is then activated to serve as an audible alarm, while the ESP32-CAM module captures a photo of the surroundings. These images and alerts are forwarded to the user via the Telegram application, allowing for remote monitoring. Additionally, a mini-UPS and a battery provide backup and main power sources respectively, ensuring the system remains operational during power outages. A power transformer regulator is also included to stabilize the voltage supplied to the system. Furthermore, an RFID module is integrated as a security feature for locking and unlocking the system. In terms of variables, the independent variable in this study is the SW 420 vibration sensor, which detects forced movement and sends corresponding signals to the system. The dependent variables include the ESP32, buzzer, camera, and Telegram application. These components respond to the input from the vibration sensor: the ESP32 transmits signals, the buzzer emits an alarm, the camera captures images, and Telegram delivers notifications to the user's mobile phone.

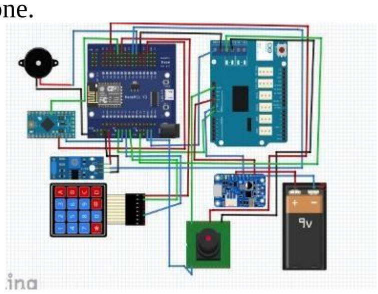

Fig. 4. Schematic System

III. RESULT AND DISCUSSION

A. Test Sensor Vibration & Notification Telegram

The Arduino functions as the main controller or "brain" of the system, managing all processes. The ESP32 module acts as the communication and control interface that connects the sensor with other devices. The SW 420 vibration sensor serves as the independent variable, responsible for detecting vibrations caused by forced movement. When vibrations are detected, the Arduino processes the signal from the sensor and transmits it via the ESP32 to trigger various system outputs. One such output is the buzzer, which serves as an audible alarm to alert users. Additionally, the ESP32-CAM module automatically captures images and sends them through the Telegram application to the user's mobile phone as a notification. The system is also equipped with backup power sources, including a mini-UPS and a battery, to ensure continued operation during power outages. A power transformer regulator is included to stabilize the voltage supply. Another component is the RFID module, which functions as a security locking system. In this study, the independent variable is the SW 420 vibration sensor, which detects vibrations and serves as the main trigger for the system. The dependent variables include the ESP32, buzzer, camera, and the Telegram application. These components respond to the input from the vibration sensor: the ESP32 transmits data, the buzzer sounds an alarm, the camera captures images, and Telegram sends notifications to the user's device. Thus, the system is designed as an automatic vibration-based monitoring and security solution.

Fig. 5. Prototype

Based on the results of the prototype testing conducted On table 1, there are two main focuses, namely testing the SW420 vibration sensor and testing the voltage stability against load variations. In the SW420 sensor test, vibration detection time delay measurements were carried out against variations in touch distance, namely 10 cm, 20 cm, and 30 cm. The results show that the further the distance, the greater the delay time. At a distance of 10 cm, the measured delay was 0.149944 seconds, while at a distance of 20 cm it increased to 0.776951 seconds, and at 30 cm it became 1.296725 seconds. This shows that the sensor works well at close range, but its sensitivity decreases with increasing distance, which can affect the speed of system response in real-time applications.

TABLE 1. Experiment Vibration Sensor

Jarak Sentuhan (cm)	Delay Waktu Deteksi (detik)
10	0,149944
20	0,776951
30	1,296725

Meanwhile, load testing was conducted to evaluate the stability of the output voltage when given a graded load from 2 watts to 6 watts. In the three experiments with loads of 2W, 4W, and 6W respectively, the output voltage remained stable at 4.8 volts, and all experiments produced an "OK" status. This shows that the prototype electrical system is able to maintain voltage stability even when the load increases. This performance indicates that the power supply components work reliably under light to medium load conditions.

TABLE 2. Experiment Load

Percobaan	Beban (Watt)	Output (Volt)	Hasil
1	2	4,8	OK
2	4	4,8	OK
3	6	4,8	OK

Overall, the prototype performed quite well. The SW420 sensor is effective in detecting vibrations at close range, while the power system is proven to be stable in the face of load variations. However, for further development, it is recommended to conduct additional tests with a larger distance and higher load to evaluate the performance limits of the overall system.

Notivikasi jika kartu sudah terdaftar	Akses diterima, kotak amal dibuka 10:25
Notivikasi jika kartu belum terdaftar	Akses ditolak, kotak amal diakses dengan kartu belum terdaftar 10:26
Notivikasi jika kotak terjadi guncangan	Terdeteksi guncangan, segera amankan kotak amal 10:26
Notifikasi dan gambar dari kamera	

Fig. 6. Notification Telegram

In this prototype design, no errors can be found in the performance of the sensors. However, there is a weakness, namely the placement of the camera is not suitable so that it cannot get the face of a person suspected of being a thief. Another weakness is that the sensor parameter settings are too sensitive, making it difficult to distinguish between normal vibration and abnormal vibration.

IV. CONCLUSION

The implementation of cameras connected to IoT networks enables real-time monitoring of charity boxes, allowing managers to observe activity around the boxes and assess their condition without being physically present. Additionally, the integration of vibration sensors enhances security by detecting unusual movements or suspicious actions. In the event of such occurrences,

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instant notifications are sent to authorities via Telegram, enabling prompt and appropriate responses. The use of Telegram as a notification platform ensures efficient and direct communication, allowing managers to quickly address any issues and maintain the safety and integrity of the charity boxes.

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