IoT: Theft detection of the mosque charity box through Arduino R3 with HC-SR501 sensor and MC-38 sensor

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Abstract. The purpose of this research is to detect and store data on theft of mosque charity boxes using the Internet of Things (IoT) by activating short message notifications on smartphones and database servers through a web framework. The focus of this research is the use of Arduino R3 as a microcontroller that regulates the detection of theft of a mosque's charity box with a passive infrared sensor HC-SR501, a magnetic switch sensor MC-38, and sending short message notifications and storing detection results to a database server. Arduino R3 is used as a microcontroller with a program that can be recycled using the Arduino IDE, while the HC-SR501 passive infrared sensor is used to detect human movement with changes in body heat, through infrared rays emitted by a Fresnel lens, then identified by the pyroelectric sensor made from gallium nitride (GaN), cesium nitrate (CsNO₃) and lithium tantalate (LiTaO₃), a change in heat temperature then activates the buzzer when a hot object is detected. Whereas the MC-38 magnetic switch sensor functions to turn on the buzzer when the mosque charity box is forcibly opened by a thief with a normally closed and normally open angle. The results obtained from this study are testing the MC-38 magnetic sensor has two working modes, namely normally close when the two beam blades fuse within a distance of < 3 cm, above a distance of > 3 cm, normally open, meaning that the conditions are not safe. While the test results of the HC-SR501 PIR sensor have the ability to detect body movements with a minimum reading distance of 30 cm and a maximum of 10 m, with LOW results if not detected and High if detected by human objects.

1. Introduction

The background of this research is the increase in the number of thefts of charity boxes at the Grand Mosque of Arumsari Cirebon district from one case per month to three cases per month. The purpose of this research is to make an early detection tool for the theft of a mosque's charity box using Arduino R3 with the HC-SR501 passive infrared sensor (PIR) sensor for human motion detection and the MC-38 door magnetic switch sensor to detect attempts to force open the box thief. the mosque's charity.

Arduino R3 is an open source electronic circuit board with the main component being a microcontroller chip of the AVR type (Alf Vegard Risc Processor) from the Atmel company where the chip or integrated circuit can be reprogrammed through a computer application called the Arduino IDE which is used to read input, process and produce output. according to the needs of these devices, such as controlling a robot wheel to track and avoid obstacles, measuring the calorimeter construction.
independently, measuring particulate matter in an educational environment, developing a control system on a dual effect absorption cooler with LiBr / H2O, measuring the amount of melamine in infant formula with a spectrometer raman which can be controlled by controlling the rotation performance, adjusting the volume of breast milk with a portable double pump microcontroller, measuring transendothelial electrical resistance, and regulating office lighting with an intelligent system [1]–[9]. Arduino can also be used for low-cost air quality monitoring, basic theory learning, monitoring irrigation water usage, signal development systems, automation system integration on smart grids, keyless entry systems, high-precision cavity-based resonance displacement, low cost portable devices for measuring methane in biogas [10]–[17], as well as used as visual reality, continuous environmental quality monitoring, and is used for the design and development of PV-T test benches [18]–[20].

The use of passive infrared sensors with Arduino devices is needed to detect changes in human body temperature, such as mapping occupancy patterns, house door motion systems, solar-powered lawn mower robots, low-cost integrated sensing networks, building occupancy measurements, for intrusion in agricultural land [21]–[26], analyzing the impact of heterogeneity and surface roughness, setting street lighting systems, managing occupancy estimates, indoor human location [27]–[30], home security systems using object recognition, analog response modeling, and lighting control with motion detection [31]–[33].

While the use of switch magnetic sensors is used to detect normally open and normally closed which are used for learning physics materials [34], production safety monitoring [35], quantum-based microwaves, to adjust the optical fiber magnetic field, for conductor position error analysis, to design and amorphous wire fabrication, and for studies of the bending strength of reinforced concrete beams [36]–[40].

2. Methodology
The experimental method is the method used in this study to explain each stage of the research in detecting the theft of the mosque's charity box in layers with the Arduino R3 device. While the sensors used are two sensors, including the HC-SR501 passive infrared sensor (PIR) motion detection sensor and MC-38 door magnetic switch sensor.

2.1 Research Flow
In general, the stages of the research are illustrated as follows. In the first process, the research focused on references in the form of previous research articles both journals and proceedings, especially those related to this research, namely Arduino R3, HC-SR501 passive infrared sensor (PIR) or often referred to as pyroelectric sensors because of their ability to detect human body temperature through reflected light, infrared, and the magnetic sensor is the MC-38 door magnetic switch sensor.

![Figure 1. Flow of research carried out](image)

After the literature study process, then proceed with designing the hardware and software needed in this study. For hardware, the tools or materials needed are Arduino R3 microcontrollers, HC-SR501 passive infrared sensor (PIR) and MC-38 door magnetic switch sensor, while the software needed is Arduino IDE, Notepad ++ as the editor, and a web server and browser to display the results. Then the
next process is the manufacture of hardware and software which is the realization of the previous stage, namely design. While the prototype testing process is needed to measure the effective distance from the HC-SR501 passive infrared sensor (PIR) or pyroelectric sensor required to record video by Arduino R3, then measure the normally closed and normally opened angles required by the MC-38 door magnetic switch sensor to activate the buzzer installed on the Arduino R3.

3. Result and Discussion
The following are the results obtained from research on the detection of theft of a mosque's charity box with an Arduino R3 microcontroller with the HC-SR501 passive infrared sensor (PIR) sensor and MC-38 door magnetic switch sensor.

3.1 Result
The web-based application used in this study is a means of collecting sensor data used. Where the data obtained from the report can be dated according to the need for data analysis. Figure 2 shows the data in the form of a Chart Line from the HC-SR501 PIR sensor data stored in the Web application database. Where the X (Horizontal) axis shows the reading date data and the Y axis (Vertical) shows the value read by the sensor. Figure 3 shows the HC-SR501 PIR sensor data stored in the Website Database in tabular form. By clicking on the EXPORT button the Print data will be processed. The HC-SR501 PIR sensor data during the printing process can be filtered according to the desired date. So that it can facilitate monitoring of sensor data.

Figure 2. Displays the HC-SR501 PIR Sensor 1
Figure 3. Displays the HC-SR501 PIR Sensor 2

Figure 4 shows a Chart Line of the MC-38 magnetic sensor data stored in the Web Application Database. Where the X (Horizontal) axis shows the reading date data and the Y axis (Vertical) shows the value read by the sensor. Figure 5 shows the MC-38 magnetic sensor data stored in the Website Database in tabular form. By clicking on the EXPORT button, the Print data will be processed. The same thing as the PIR sensor, the magnetic sensor data when Print can be filtered according to the desired date. So that it can facilitate monitoring of sensor data.

Figure 4. Display magnetic sensor data 1
Figure 5. Displays MC-38 magnetic sensor data 2

3.2 Discussion
The test results of the MC-38 magnetic sensor have two working modes. First is normally close, which is a condition when the two beam blades are together or are in a very close distance < 3 cm. So that the sensor will provide LOW input to the micro controller, the test results are in Figure 6. And the second mode is normally open, which is a condition when the two beam blades are more than 3cm apart. So that the sensor will provide HIGH input to the micro controller. The test is that the two magnetic
sensor blades are placed at a distance of < 3 cm. In this condition, it is defined that the charity box is safe. So that the sensor will provide LOW input to the micro controller, the test results are in Figure 7.

While the test results of the HC-SR501 PIR sensor have the ability to detect body movements of living things, especially humans. With a minimum reading distance of 30 cm and a maximum of 10 m. What this sensor detects is a change in the infrared frequency in its work area that is triggered by a human moving. If this sensor is exposed to a human body that is in a stationary state, there will be a possibility that the sensor will not react, because the infrared frequency generated by humans is constant. The way the HC-SR501 PIR sensor works is similar to a magnetic sensor in sending information to the micro controller, that is, when it doesn't detect movement, the sensor will input LOW to the micro controller, the test results are in Figure 8. On the other hand, if it detects motion it will perform HIGH input to the micro controller. If there is a human being (who makes a movement), then Detected Movement is defined. Where the sensor will provide HIGH input to the microcontroller, the test results are in Figure 9.

4. Conclusion
The use of Arduino R3 can detect human activity by adding the HC-SR501 PIR sensor to detect human objects with a minimum distance of 30 cm and a maximum of 10 meters. Meanwhile, the MC-38 magnet sensor has two working modes, namely normally close and normally open.

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