



# Design of a Paper Money Counting Tool for the Infaq Charity Box of Syarikatul Anwar Mosque Based on the Internet of Things

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## Abstract

Mosque financial management, especially the calculation of charity box balances, is often done in a homemade manner so that it is less efficient and prone to errors. This research designed a prototype of a smart charity box based on the Internet of Effects (IoT) using a TCS3200 color detector to detect the nominal amount of bank notes automatically. The detection data is displayed in real-time via a web or Android application. The system integrates an Arduino microcontroller with a detector and a communication module to provide high accuracy in detecting money. As a result, the system is able to reduce primary workload, increase transparency, and speed up the calculation of mosque balances.

*Keywords: Internet of Things, smart charity boxes, mosque financial management.*

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## 1. Introduction

The Internet of Things (IoT) has rapidly evolved over the past decade, transforming industries, agriculture, transportation, and even social and religious services. IoT enables physical devices such as sensors, actuators, and microcontrollers to connect and communicate via the internet, creating integrated smart systems [1]. In the context of mosques and donation box management, IoT presents a modern and efficient solution to replace conventional methods. One practical application is the IoT-based automatic money counting system for donation boxes, where sensors detect banknote values, and devices like the ESP32 with Wi-Fi modules transmit real-time data to Telegram. This allows mosque administrators to monitor donations anytime and anywhere without physically opening the donation boxes [2].

At Masjid Syarikatul Anwar in Bogor, donation boxes play a crucial role in funding mosque maintenance and social programs. Currently, donations are counted manually, a process that is time-consuming, error-prone, and less transparent [3]. Such inefficiencies can hinder accountability and reduce community trust. By implementing an IoT-based solution, the money counting process becomes automated, providing real-time updates while minimizing manual effort. This innovation not only enhances efficiency but also strengthens transparency and accountability in financial management [4].

The proposed system uses a color sensor to automatically detect and count inserted banknotes, while the ESP32 microcontroller connects the device to the internet for real-time data transmission. A Wi-Fi module enables communication with applications like Telegram, allowing administrators to track donation growth easily and transparently [5]. Each donation is automatically recorded and organized, ensuring structured data management. The system applies the Rapid Application Development (RAD) method, which emphasizes fast prototyping and iteration, enabling quick deployment and refinement of the technology for practical use at the mosque [6].

Overall, the IoT-based donation box significantly reduces reliance on manual counting, minimizes human error, and saves time. It enhances transparency in financial reporting, improves efficiency in donation management, and strengthens security by allowing remote monitoring [7]. By adopting such a system, Masjid Syarikatul Anwar can modernize its financial practices, foster greater trust among the congregation, and serve as a reference model for future research and IoT applications in religious and social institutions [8].

## 2. Research Methodology

### 2.1. Rapid Application Development (RAD)

The development model used in this study is the Rapid Application Development (RAD) method, which consists of four main stages: requirements planning, system design, development, and implementation. This approach emphasizes rapid prototyping and iterative

processes to ensure that the system is built efficiently, meets user needs, and can be deployed effectively [9]. The RAD system development approach is illustrated in the figure below.

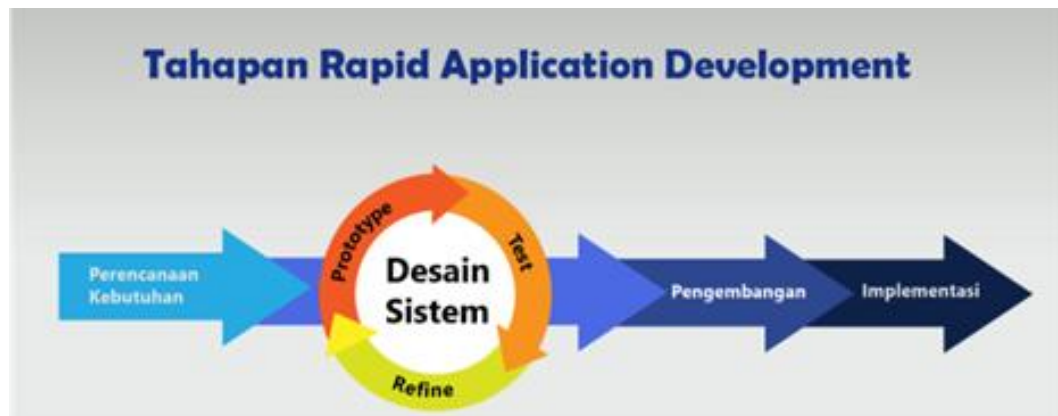


Fig. 1: Rapid Application Development (RAD)

The stages of the RAD method are explained as follows:

1. **Requirements Planning:**  
System requirements were identified through discussions with the mosque's management (DKM Masjid) and stakeholders. The main goal was to analyze existing problems and define solutions through the design of an IoT-based donation box. Both hardware needs (ESP32, color sensor, OLED display) and software needs (Telegram integration for real-time monitoring) were analyzed.
2. **System Design:**  
This stage included creating block diagrams, system flow, hardware component design, and user interface layout. The design focused on how the color sensor detects banknotes, how the ESP32 processes and displays data on the OLED screen, and how information is transmitted to Telegram in real time.  
**Prototype:** An IoT donation box prototype was developed by integrating hardware and software components.  
**Testing:** The prototype was tested for sensor accuracy, data processing, and data transmission to Telegram, through both alpha and beta testing.  
**Refine:** Results from testing were used to refine system performance, improve detection accuracy, processing speed, and interface display.
3. **Construction:**  
System development was carried out based on the planned design and defined requirements. Prototyping and testing ensured that the IoT donation box system met functional and operational needs.
4. **Deployment:**  
The IoT-based donation box system was implemented at Masjid Syarikatul Anwar, ready to be used for efficient and transparent donation management.

### 3. Result and Discussion

Currently, the money counting process at the donation boxes of Masjid Syarikatul Anwar is still carried out manually, which is time-consuming and prone to human error. To address this issue, an IoT-based system is designed to automate and speed up the counting process. The system is illustrated through a block diagram that provides a clear visual representation of the workflow [10]. In this design, a power bank supplies energy to the ESP32 NodeMCU, while a color sensor detects the banknotes and sends the data to the microcontroller. The ESP32 processes the data to identify the value of the banknotes, displays the result on an OLED screen, and sends real-time information to Telegram for remote monitoring [11]. A push button is also included for training the system to recognize different denominations, with all programming and data processing conducted via Arduino IDE.

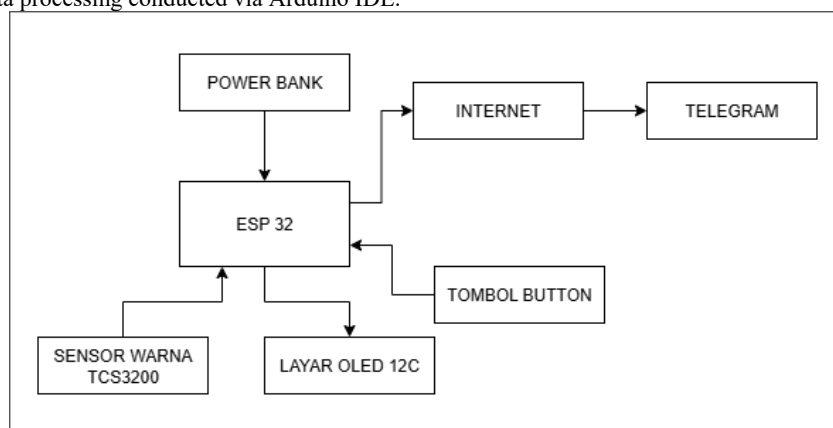


Fig. 2: Block Diagram

The proposed IoT-based donation box system integrates several hardware components, including the ESP32 microcontroller, TCS3200 color sensor, 128x64 OLED display (I2C), push button, and power bank. The color sensor is installed inside the donation box to detect and

count banknotes as they are inserted, while the OLED screen placed on the front displays the total amount in real time [12]. The push button functions as a training input for banknote recognition, ensuring accuracy in detection. This design allows for automated, efficient, and transparent donation counting, reducing reliance on manual processes and enhancing both accuracy and efficiency in financial management for the mosque [13].

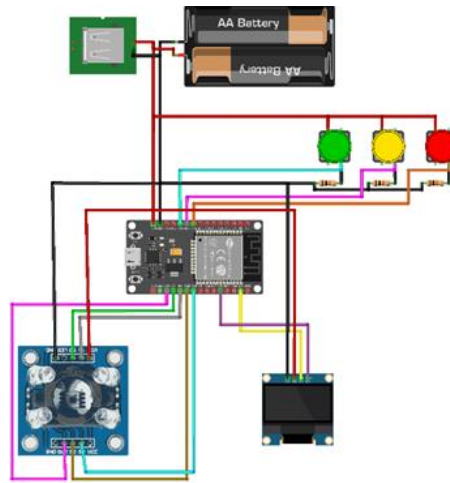


Fig. 3: Overall System Design

### 3.1. Hardware Requirements

The hardware requirements used to ensure the system runs properly are listed in the following table:

Table 1: Hardware Requirements

No	Component Name	Quantity	Component Function
1	NodeMCU ESP32	1 (one)	The main microcontroller that controls all components, processes sensor data, and sends output to the display. It can also be used for internet connectivity if needed (IoT).
2	Color Sensor (TCS3200)	1 (one)	Detects the color of the banknotes inserted into the device. Each color can be mapped to a specific denomination.
3	OLED Display 128x64 (I2C)	1 (one)	Displays the detected banknote denomination and the total amount in real-time.
4	Push Button	1 (one)	Used for manual control and banknote configuration.
5	Capacitor 10 $\mu$ F 25V	1 (one)	Functions to stabilize voltage and prevent current surges in the circuit.
6	Jumper Wires	Several	Used to connect different parts of the device from one pin to another.
7	BreadBoard	1 (one)	A temporary medium for assembling components without soldering.
8	Power Bank	1 (one)	Provides portable power supply to the device, including NodeMCU ESP32 and other components (sensor, OLED display, etc.).

### 3.2. Software Requirements

The software requirements used in the system design for money-counting alerts with Internet of Things (IoT)-based notifications can be seen in the following table:

Table 2: Software Requirements

No	Software Name	Function
1	Arduino IDE	Used to create and upload programs that enable the ESP32 to detect banknote colors, calculate their nominal value, and display the results on the screen or send them to Telegram.
2	Telegram	An application for remote monitoring to view updates of the collected money without having to be physically present at the mosque or open the donation box.

### 3.3. Hardware Implementation

The hardware implementation was carried out by assembling the components using an ESP32 board and jumper wires to connect all parts. The ESP32 functions as the main control center, processing data from the connected sensors and output devices [14]. The TCS3200 color sensor is used to detect the denomination of banknotes inserted into the donation box, while the 128x64 OLED display presents the detected values in real time, showing amounts such as Rp. 1,000, Rp. 2,000, Rp. 5,000, Rp. 10,000, Rp. 20,000, Rp. 50,000, and Rp. 100,000 using I2C communication. A power bank serves as the power supply, providing portable energy to the ESP32 and ensuring the system operates independently and efficiently [15].



Fig. 4: Hardware Implementation

### 3.4. Telegram Implementation

In this stage, the IoT-based donation box system is integrated with the Telegram application to enable real-time monitoring by mosque administrators. The main features include Reset Balance, Incoming Money, and Total Money. The Reset Balance feature resets the recorded amount to zero when starting a new calculation, ensuring data accuracy. The Incoming Money feature displays each banknote detected by the sensor, with its nominal value automatically sent to Telegram for instant tracking of donations. The Total Money feature shows the accumulated amount of all detected banknotes, updated in real-time, allowing administrators to quickly and transparently monitor the overall funds collected.

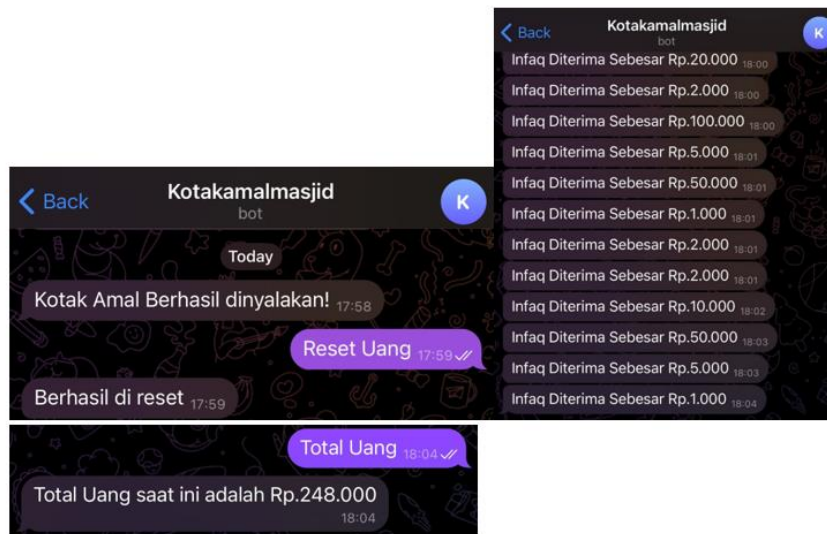


Fig. 5: Telegram Log

### 3.5. Alpha Testing

Alpha testing aims to ensure that both hardware and software components of the system function correctly, both individually and in integration. This stage focuses on verifying functionality and performance in line with the design specifications, including hardware performance experiments conducted to test the reliability and effectiveness of the developed device.

Table 3: Hardware Experiment Testing

No	Hardware	Testing Description	Expected Result	Outcome
1	NodeMCU ESP32	Receives and processes data from all sensors, and controls all outputs such as the OLED display and Telegram.	Able to execute the entire system logic and integrate with other components.	Successful
2	TCS3200 Color Sensor	Detects money inserted into the donation box.	Able to detect money inserted into the donation box.	Successful
3	Push Button	Used to access the money training data menu.		Successful

			Able to access the money training menu.	
4	TCS3200 Color Sensor	Stores the trained money data results.	Successfully stores the trained money data results.	Successful
5	OLED Display (I2C)	Displays information about the detected money.	Able to display information about the detected money.	Successful
6	Power Bank Battery	Provides power supply for the entire system.	Able to supply power to the system during operation.	Successful

## 4. Conclusion

Based on the results of this research, the IoT-based smart donation box system at Masjid Syarikatul Anwar successfully optimized the process of counting cash donations automatically and in real-time. The system uses a color sensor to detect the nominal value of banknotes and transmits the data via ESP32, ensuring efficient and accurate processing. Its integration with the Telegram application further enhanced efficiency, transparency, and accountability in donation management by providing automatic transaction records and real-time notifications for mosque administrators. This innovation not only reduces dependence on manual processes but also improves financial transparency, strengthens accountability, and provides greater security against risks such as theft or manipulation.

For further improvement, several recommendations are suggested. From a managerial perspective, mosque administrators should assign dedicated personnel to monitor and manage the system's data, provide technical training for troubleshooting, and use the system as part of transparent financial reporting to the congregation. From a system perspective, higher-quality sensors, data encryption, and real-time security alerts should be considered, along with more user-friendly monitoring applications. For future research, enhancements such as image processing for currency recognition, broader field testing in different mosque environments, and adaptation to various banknote types are recommended to further improve accuracy, usability, and reliability.

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