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Design and Implementation of a Digital Donation Box with Automated Coin Sorting System

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Abstract: *The digital donation box is a new and innovative approach to the traditional method of collecting donations for charities and non-profit organizations. This system utilizes an Arduino microcontroller, which serves as the brain of the donation box, to automate the donation process and provide greater transparency and security to donors. The system is designed to accept various forms of payment, including all types of coins. The donation box also incorporates an LCD that shows real-time updates on the donation, and a switch is used to display the total amount collected in the box. The entered coins will be separated and collected in different boxes, which will help the management monitor the system. This project can potentially revolutionize how charitable organizations collect donations, making the process more efficient, secure, and transparent.*

Keywords: Component, Formatting, Style, Styling.

I. INTRODUCTION

A digital donation box is a device that allows individuals to donate money to a charity or non-profit organization electronically. Unlike traditional donation boxes, which typically involve physical coins or bills being deposited, digital donation boxes accept payments using credit cards, debit cards, and other electronic payment methods.

Digital donation boxes can take various forms, from simple donation buttons on websites to more sophisticated kiosks or interactive displays that enable donors to make donations in person. Some digital donation boxes even incorporate features such as touch screens, audio and video presentations, and real-time progress indicators to encourage giving.

Digital donation boxes have become increasingly popular in recent years as more people have embraced online and mobile payments. They offer convenience and accessibility, allowing people to donate from anywhere at any time. They also provide charities a new way to reach potential donors and increase their fundraising efforts.

Traditional donation boxes have been a significant source of income for non-profit organizations, religious institutions, and other charitable causes. However, with the increased digital transactions and the current pandemic, many people hesitate to donate using physical currency. The need for a digital donation box has become more critical than ever.

Therefore, the problem statement is to develop a digital donation box that can accept donations using various digital payment methods such as credit/debit cards, mobile wallets, and online payment gateways. The digital donation box should be user-friendly, secure, and accessible to people of all ages and backgrounds. Additionally, the donation box should be able to track donations, generate reports, and provide real-time updates to the organization or charity receiving the funds.

The solution to this problem will help organizations collect donations more efficiently and provide convenience and transparency to donors, ultimately resulting in increased charitable contributions.

An automatic coin separation digital donation box is a device that accepts and separates coins of different denominations, counts them, and provides a digital display of the total amount collected. This type of donation box is designed to make collecting donations easier and more efficient, particularly for non-profit organizations, charities, and fundraising events.

The device typically includes a coin acceptor recognising and accepting coins of different denominations. Once the coins are inserted, they are separated by the device into different compartments based on their denomination. The device then counts the coins and provides a digital display of the total amount collected.

II.LITERATURE SURVEY

E. Rukzio et al. [1] present "The Design and Evaluation of a Digital Donation Box". This paper presents a case study of designing and evaluating a digital donation box for a charity. The authors discuss the design process, the technical implementation, and the evaluation of the system's effectiveness in collecting donations.

D. Brown et al. [2] present the Digital Donation Systems: A Framework for Design and Implementation. This paper proposes a framework for designing and implementing digital donation systems. The authors discuss the key features of successful digital donation systems, including ease of use, security, and integration with existing systems.

S. Radu et al. [3] proposed "Building Trust in Digital Donations: The Impact of Third-Party Seals on Online Charitable Giving." This paper examines the impact of third-party trust seals on online charitable giving. The authors conduct experiments to test the effectiveness of different trust seals in increasing donor trust and donations.

J. Tang et al. [4] present "Design and Evaluation of a Mobile Digital Donation System for Disaster Relief." This paper presents the design and evaluation of a mobile digital donation system for disaster relief. The authors discuss the technical implementation, the user interface design, and the evaluation of the system's effectiveness in collecting donations.

Y. Liu et al. [5] present a system called Crowdfunding for Social Good: A Study of Perceived Benefits and Challenges of Digital Philanthropy. This paper examines digital philanthropy's perceived benefits and challenges, including crowdfunding. The authors survey donors to understand their motivations, perceptions, and experiences with digital philanthropy and discuss the implications for non-profits organizations and charities.

A Rotational invariant neural pattern recognition system for coin recognition is presented by **Minoru Fukumi et al.** in a paper [6]. The pre-processing of this work's multilayer neural network comprises many slabs of neurons. This pre-processing was utilised to acquire rotating inductive inputs for multilayer neural networks. Instead of using a square array, a circular array was employed to represent the weight of neurons in the pre-processor. 1993 saw an attempt to make coins entirely accurate. In this study, he has created neural networks for coin recognition using backpropagation and genetic algorithms. The network is trained via backpropagation.

To categorise freshly released Indian coins of various denominations and to calculate the overall value of coins in Indian national rupees, A method to distinguish freshly released Indian coins is provided by **Velu CM et al.** [7]. The value must be divided into denominations and totalled. Coin about the Indian Rupee (INR). Systems include the multilevel counter progression neural network (MLCPNN) based approach (99.5 percent accuracy), the canny edge detection technique (97.5 percent accuracy), the Gaussian edge detection method (94 percent accuracy), and Robert's edge detection method (93 percent accuracy). Size, shape, surface, weight, and other parameters are considered, and MATLAB is utilised as a platform for modelling and generating results. Modi et al. evaluated comparisons of current methods, focusing on image processing methods, and discovered that decision trees could identify Canadian coins with a maximum accuracy of 99.7% in 1996.

The FLA (Field Processed Gate Array) controller and MATLAB were used to recognise currency notes and check for inaccurate and counterfeit notes in the Indian currency identification and coin fall reported by **Anija KP et al.** [8]. Artificial neural networks calculate the currency's value if the notes are actual. A DC gun is available for the sorting procedure.

Rohan S.'s SIFT technique was used to recognise and sort Indian coins. [9] The proposed system uses the SIFT method and the MATLAB coin identification tool. To distinguish between various coins, it employs feature extraction algorithms. He employed similar edge-detection methods to find coins.

By adjusting the level of normalisation, **Paul Davidsson et al.** [10] demonstrate Coin categorization utilising a cutting-edge method for learning characteristic decision trees. Controlling the level of normalisation in this study offered a method for coin categorization utilising certain decision trees. The set of decision tree training examples did not contain any instances of the categories that algorithms like ID3 might find. Such examples are assigned to one of the classes represented in the training set rather than being rejected. Obtain a recognition accuracy rate of 100 percent. The picture was smoothed during the pre-processing step using a Gaussian filter, and then a binary image was created using grey-level thresholding. The team employed a Harris-Hassian detector to extract the characteristics. The limit value of the coin's distinctive points is then determined. For circle detection, the Circle Hof transform is employed. The coins are categorised based on threshold value and radius following circle detection.

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M. Adameck et al. [11] present three colour-selective stereo gradient approaches for quickly identifying the topography of metal surfaces. Transfection is used to establish translational invariance, similar to our method, while polar coordinate representation and correlation produce rotational invariance. Its method uses specialised technology to ensure that it does not accept any fake coins. There is no chance that the system will receive fake images of coins. Therefore, it appears that using colour adds unnecessary expense to computation. The picture of the coin explains the fundamental concept of a straight-line detection technique. Rating criteria for coins are discussed based on grey level, colour, texture, form, model, etc. The approach explicitly addresses the coins' segmentation based on colour or grey value. It is attempted to identify several grave issues, such as the coin's size and the peak in its surface, but little progress has been made.

Pattern matching with a rotation-invariant coin identification system and a neural network is presented by **Sabita Pa et al.** [12]. This technology can gather information and identify coin attributes. The RGB coin picture is captured in the first step. After that, a grayscale version of the RGB image is created. They employed the Sobel filter to determine the radius and centre of the picture and its boundaries. The feature vector was created in the next phase. Then, trained neural networks are added to this feature vector. The neural network subsequently classifies the coins.

The Indian coin recognition image subtraction method is presented by **Harveen Kaur et al.** [13]. The system verifies the picture of the coin's radius and centroid before applying coarse and fine subtraction to the input image. The database coin image and the item picture are subtracted, resulting in quick and accurate identification.

They employed a Gaussian filter to smooth the picture in the Harris-Hessian method for coin anticipation, published by **Saranya Das** [14], before performing grey-level thresholding to produce a binary image. The team employed a Harris-Hassian detector to extract the characteristics. The limit value of the coin's distinctive points is then determined. For circle detection, the Circle Hof transform is employed. The coins are categorised based on threshold value and radius following circle detection.

Tushar N. Nimbhorkar presents coin identification using artificial neural networks [15]. They have identified the circular border using Sobel edge detection. He applied the circular huff transform to make the picture of the coin free of shadows. They used wavelet and discrete cosine transformations to separate the picture into smaller pieces. After that, the average pattern picture is created. Vectors are created and provided to the neural network as input in the last step.

III.PROPOSED SYSTEM

The block diagram of the proposed digital donation box system is shown in Fig. 1.

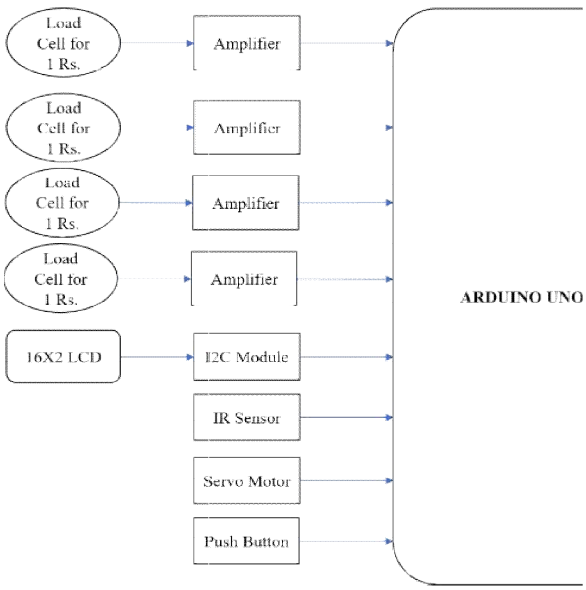

Figure 1: Block diagram of proposed digital donation box

According to our findings, we have designed a block diagram for our project in the diagram above. The block diagram includes the essential controller, which is Arduino UNO. This controller maintains and controls the input from the load

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cell amplifiers and provides the data to LCD. The load cells calculate the total donation amount using the single coin's weight. In the load cell, we have used four different coins, which will be collected in four different containers with the help of a mechanism. The mechanism includes coin separation using the size of the coins. Once the coins are separated in the containers, the load cell under the container will get the total weight from the load cell using an amplifier. We will get the overall weight of coins from each load cell amplifier in each container. While calibrating the weight of each coin, we can now calculate the total coins in each container. We can modify the number of coins to the total amount in each container by multiplying the amount.

The components used in this project are:

- **Arduino UNO**

  Arduino Uno is based on the ATmega328P microcontroller, a popular open-source microcontroller board. It is one of the Arduino family's most popular boards and an excellent choice for novice and expert users.

  The board contains a 16 MHz quartz crystal oscillator, six analogue input pins, 14 digital input/output pins, a USB connector for power and programming, a power jack, an ICSP header, and a reset button. An external power source or a USB connection may power it.

  The Arduino Integrated Development Environment (IDE), a free piece of software that enables users to create, compile, and upload code to the board, may be used to programme the Arduino Uno board. The IDE makes it simple for newcomers to use a condensed version of the C++ programming language.

  The board is extensively utilised for various projects, including Internet of Things (IoT) applications, home automation, and robots. A versatile and adaptable platform for experimentation and prototyping, it is also compatible with various sensors, shields, and other add-ons.

- **Load Cell**

  A transducer that measures force or weight is called a load cell. It is a sensor that transforms any weight or force placed on it into an electrical signal that can be measured and examined. Load cells are often employed in many different applications, including weighing scales, industrial automation, robotics, and material testing.

  A load cell typically consists of a strain gauge, which is a device that measures the change in resistance when it is subjected to stress or strain. The strain gauge is bonded to a metal or alloy beam, which deforms when a force or weight is applied. The deformation of the beam causes a change in the resistance of the strain gauge, which is measured by an electrical circuit. The magnitude of the change in resistance is proportional to the applied force or weight.

- **Signal Amplifier (HX711)**

  The HX711 is a signal amplifier and analogue-to-digital converter (ADC) integrated circuit (IC) designed for weight and force measurement applications. The analogue output signal from a pressure sensor or load cell is frequently amplified and converted into a digital signal that a microcontroller or computer can read.

  The HX711 chip uses a differential input to measure the input signal from the load cell or pressure sensor. The differential input allows the HX711 to measure small changes in the input signal with high accuracy and resolution. The HX711 has a programmable gain amplifier set to different gain levels, optimising the amplifier for different input signal ranges.

  The HX711 has two separate channels, simultaneously measuring two separate input signals. This can be useful in applications where multiple sensors are being used to measure different forces or weights.

  The HX711 outputs the converted digital signal using a serial communication protocol such as SPI or I2C. The output data is a 24-bit binary code representing the amplified and digitized input signal.

- **I2C LCD**

  I2C LCD is a type of liquid crystal display (LCD) that uses the I2C (Inter-Integrated Circuit) protocol for communication with a microcontroller or other device. SDA (Serial Data Line) and SCL (Serial Clock Line) are two signal channels used by the I2C serial communication protocol to connect devices.

  The I2C LCD typically consists of a display module with an integrated I2C interface module. The display module can be 16x2 or 20x4 characters, depending on the size. The I2C interface module is usually based on a chip like PCF8574 or MCP23008, which acts as an I/O expander for the microcontroller.

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To use an I2C LCD, the microcontroller sends commands and data to the display module using the I2C protocol. The commands and data are then displayed on the LCD screen. The I2C interface module acts as an intermediary between the microcontroller and the LCD module, converting the I2C signals into signals the LCD module can understand.

- **Servo Motor**

  Robotics, automation, and other fields needing precise control over angular position, velocity, and acceleration frequently employ servo motors. Servo motors use feedback mechanisms, such as encoders or potentiometers, to accurately control their rotation and position.

  A tiny DC motor, a gear train, a feedback mechanism, and a control circuit make up a servo motor. A microprocessor or other control device sends a signal to the control circuit, which determines the motor's intended position and speed. The control circuit then adjusts the voltage and current to the motor based on the feedback signal from the feedback mechanism to achieve the desired position and speed.

  Servo motors are widely used in robotics, particularly applications requiring precise control of robot joints' position and movement. They are also commonly used in industrial automation and CNC machines, as well as in remote-controlled toys and other hobbyist applications.

- **IR Sensor**

  An infrared sensor, often known as an IR sensor, is a sensor that picks up infrared radiation from its surroundings. Electromagnetic radiation having a wavelength that is longer than visible light but shorter than radio waves, is referred to as infrared radiation.

  Object identification, temperature monitoring, motion detection, and remote-control systems are just a few of the uses for IR sensors. They work by detecting the intensity of the infrared radiation emitted by an object or by detecting changes in the amount of infrared radiation in the environment.

  Passive and active IR sensors are the two primary types of IR sensors. Active IR sensors generate infrared radiation and detect the reflected radiation, as opposed to passive IR sensors, which detect the natural radiation that an item or person emits. Active IR sensors are commonly used in remote control systems, such as TV remotes, where they emit infrared radiation picked up by a receiver on the controlled device.

  IR sensors can also be classified based on their detection range, with short-range sensors typically used for object detection and motion detection and long-range sensors used for temperature measurement and remote sensing.

  The cross-platform Arduino Integrated Development Environment was created using C and C++ functions. It is employed to create and upload code to Arduino boards. A standard licence under which the IDE's source code is distributed is the GNU General Public License, version 2. With unique coding guidelines, the Arduino IDE supports languages like C and C++. A software library that is useful for several tasks, such as wiring projects, is provided by the Arduino IDE. Starting the sketch and the main programme loop are two essential operations for user-written code built, linked, and finally turned into an executable programme using the GNU toolchain included with the IDE.

IV. RESULTS

The hardware working model is presented in Fig.2.

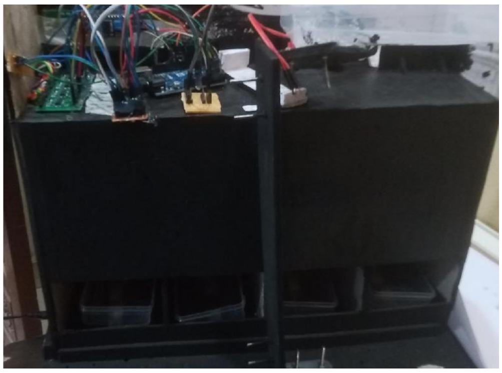

Figure 2: Block diagram of proposed digital donation box

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The electronics components are mounted on the system hardware. The mechanism of the coin sorting is placed inside the outer box. It has holes of different coin size. Vibration motor is used for movement of coin. After sorting, the weight of the coins is measure by load cell below coin bins.

The system has following test cases:

Case 1: Initialization

The system is initialization and show welcome message on the LCD.

Case 2: Initialize the weights of collection bin

Initially the collection bins are reset to 0 as shown on LCD.

Case 3: Total Amount Display

The total amount collected in the bin is calculated according to the weight of bins and display on the LCD.

One potential issue with these machines is that they may not be able to accurately sort and count coins that are damaged or worn, as these coins may weigh slightly less or more than their standard weight. Additionally, some types of coins may have similar weights, which can make it difficult for the machine to differentiate between them.

the success of a coin sorting and weighing machine depends on its accuracy and reliability. If the machine is able to accurately sort and count coins of different denominations, it can save time and reduce errors for businesses that handle large amounts of coins. However, if the machine is not accurate or reliable, it may end up causing more problems than it solves.

V.CONCLUSION

In conclusion, digital donation boxes have become increasingly popular for collecting donations for non-profit organizations and charities. The literature suggests that online giving has steadily increased over the past few years and that donors who give online tend to give more frequently and in more significant amounts than those who give offline. The success of digital donation boxes depends on factors such as user experience, security, integration with existing systems, and donor trust. Researchers have proposed frameworks for designing and implementing successful digital donation systems and have conducted studies to evaluate the effectiveness of different approaches. The digital donation boxes can potentially improve donor engagement, retention, and giving and can be an effective tool for non-profit organizations and charities to expand their fundraising efforts.

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