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Design of Automatic Pet Feeder Using Arduino

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ABSTRACT

The modern lifestyle often limits pet owners from feeding their pets on time. To address this, an automatic pet feeder system is proposed using Arduino and image processing. The system is designed to detect the presence of a pet (dog/cat) using a PC equipped with an image processing program. Once a pet is detected, the PC sends a signal to the Arduino board, which then initiates the feeding mechanism.The Arduino is connected to a Real-Time Clock (RTC) module to keep track of time-based feeding schedules. A load sensor is placed beneath the food tray to monitor the quantity of food dispensed and ensure appropriate portions are served. A servo motor is used to control the food dispenser's flap, which opens and closes as needed. An LCD display shows the feeding status and system updates. The buzzer is used to notify when food is being served or when any error is detected (e.g., tray empty or pet not detected).The image processing is carried out on a computer using OpenCV or similar libraries, which detects the pet's presence in the camera frame and sends a command via serial communication to the Arduino. This hybrid system combines real-time pet detection with smart feeding based on time and weight control.This system not only ensures timely feeding but also prevents overfeeding, supports portion control, and keeps the pet healthy in the absence of the owner. It also provides a cost-effective and efficient solution for pet care automation.

Keywords: Arduino, RTC Module, Load Sensor, Servo Motor, LCD, Buzzer, Image Processing

I. INTRODUCTION:

Pets are an integral part of many households, requiring consistent care, especially feeding at the right time and quantity. However, due to busy schedules or frequent travel, pet owners may struggle to feed their pets on time. An automatic pet feeder resolves this problem by ensuring timely and measured feeding of pets. Integrating technologies like Arduino microcontrollers, servo motors, load sensors, and real-time clocks (RTC), this system enhances automation. Additionally, incorporating image processing enables the system to detect the presence of a pet (dog/cat) before dispensing food, ensuring food is served only when the pet is present.

Objectives:

1. Only dispenses food upon detection of a pet.
2. Measures and delivers precise food quantities.
3. Operates based on real-time feeding schedules using RTC.
4. Notifies or alerts the user via buzzer and LCD.
5. Provides an affordable and reliable solution for busy pet owners.

Problem Statement:

Many pet owners face challenges in ensuring consistent feeding routines due to time constraints or absence. Manual feeding techniques are vulnerable to neglect, overfeeding, and irregularities. . There is a need for a smart system that automates the feeding process, adapts to real-time schedules, and responds to the pet's presence to avoid food wastage or hygiene issues.

II. LITERATURE REVIEW:

The design of an automatic pet feeder using Arduino has become a significant focus in the field of embedded systems and home automation due to the increasing number of pet owners seeking efficient and consistent feeding solutions. Arduino, being an open-source microcontroller platform, provides a flexible and cost-effective solution for integrating various components to automate the feeding process.

The system typically involves modules such as a Real-Time Clock (RTC) for time tracking, a load sensor for monitoring the quantity of food dispensed, a servo motor to control the food release mechanism, and an LCD display for showing system status. A buzzer is also included to provide alerts or notifications. Some advanced designs incorporate image processing via a PC to identify pets and ensure food is only dispensed for the correct animal, enhancing personalization and reducing waste. The load sensor ensures that precise amounts of food are dispensed, addressing the issue of overfeeding or underfeeding. The servo motor operates based on Arduino signals to open or close the food outlet. Feedback from the load sensor and RTC helps maintain a feeding schedule and consistency.

III. System Architecture and Components:

Block Diagram:

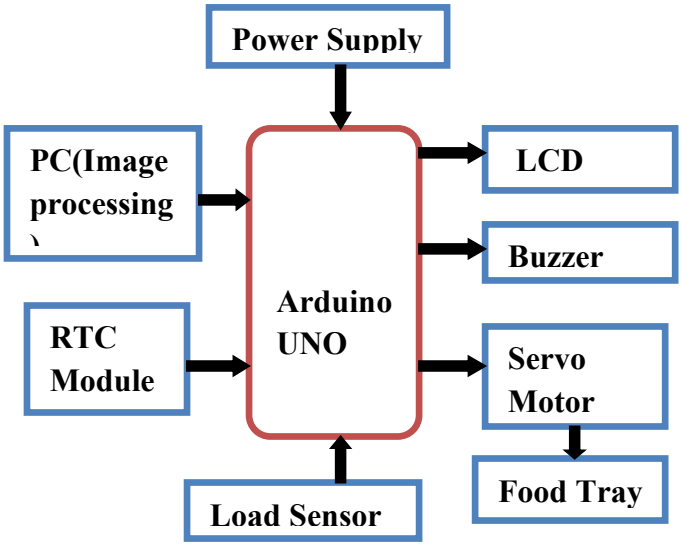


Fig 1: System Block Diagram

Hardware Components:

Arduino UNO: 1. A serial communicator is needed to program the ATmega328P microcontroller. The most common interface between a computer and a microcontroller is serial communication. One of the most used serial interfaces is UART. A piece of

hardware called a Universal Asynchronous Receiver/Transmitter (UART) converts data between parallel and serial formats. Traditionally, serial ports (DB9) are used for the majority of serial interfaces between microcontrollers and computers. However, a level shifter is required between these interfaces because the microcontroller used TTL UART and the computer serial connection used RS232 protocol. The market offers a variety of level shifters, some of which are plug-and-play USB compatible.

1.

Fig 2: Arduino UNO

An alternative to this technique is the Arduino UNO, whose inside board has all the integrated circuits required for communication. Additionally, it is built into a PCB with connectors for quick and simple prototyping.

2. **DS3231 RTC Module:** The DS3231 RTC module is a time tracking device that gives the current time and date. RTC stands for Real Time Clock. The RTC module made of clock chip DS3231. DS3231 RTC Module Pin Diagram

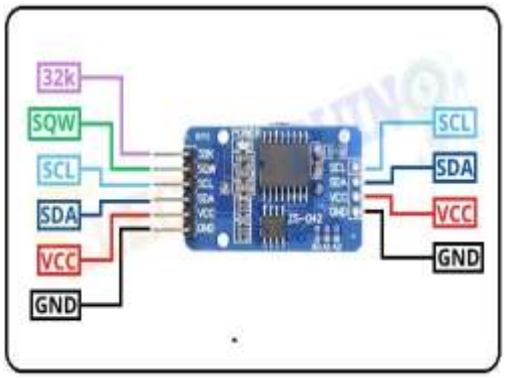


Fig 3: DS3231 RTC Module

This module is generally used in computers, laptops, mobiles, embedded system applications devices, etc. to provide time and date. RTC module works on the I2C protocol. Details like the second, minute, hour, day of the week, day of the month, month, and year—including leap year correction—are provided by the module. Another intriguing feature is that it can run in a 12-hour or 24-hour mode Its can be used in projects like containing data-logging, clock-building, time stamping, timers, and alarms.

3. **Servo Motor:** A servo motor is an electrical device which can push or rotate an object with great precision A servo motor is used when you wish to rotate an object at a certain angle or distance. It is only composed of a basic motor that is powered by a servo mechanism. If motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. A very high torque servo motor is available in a lightweight, compact design. Because of these characteristics, they are utilized in a wide range of applications, including robotics, machines, RC helicopters and airplanes, and toy cars.

Fig 4: Servo Motor

The majority of hobby servo motors have ratings of 3 kg/cm, 6 kg/cm, or 12 kg/cm. Servo motors are rated in kilograms per centimeter, or kg/cm. The weight that your servo motor can lift at a specific distance is shown by this kg/cm.

4. Load Sensor:

Fig 5: Load Sensor

A load cell is a transducer or sensor that transforms an applied force or load into an electrical signal. Depending on the circuitry and load cell type, this electronic signal may be a voltage, current, or frequency change.

5. Buzzer: This device uses the piezoelectric action in reverse to make sound. The fundamental idea is that an electric potential applied to a piezoelectric material creates strain or variations in pressure.

Fig 5.7.1: Buzzer

These buzzers can be used to notify the user of an occurrence that corresponds to a counter signal, switching action, or sensor input. Alarm circuits are another application for them.No matter how much voltage is added to it, the buzzer always makes the same loud noise. It is composed of two conductors sandwiched by piezo crystals. These crystals push on one conductor and pull on the other when a potential is placed across them. A sound wave is the outcome of this push and pull motion. The majority of buzzers emit sound between 2 and 4 kHz.

Software and Programming:

The system is programmed using:

☞ Arduino IDE: Writing and uploading C/C++ code to the Arduino is done via the Arduino IDE

☞ Python + OpenCV: For image processing on PC (pet detection).

☞Functions Programmed:

- Scheduled feeding using RTC
- Servo motor for food dispensing and Load sensor for portion measurement
- LCD for status display and Buzzer for alerts.PC communicates with Arduino for pet identification via image processing.

IV. WORKING PRINCIPLE:

☞Time Tracking: RTC module keeps real-time and signals Arduino at scheduled feeding times.

☞Control System: Arduino controls all components and starts the feeding process.

☞Food Dispensing: When a servo motor is activated, food is released into the tray.

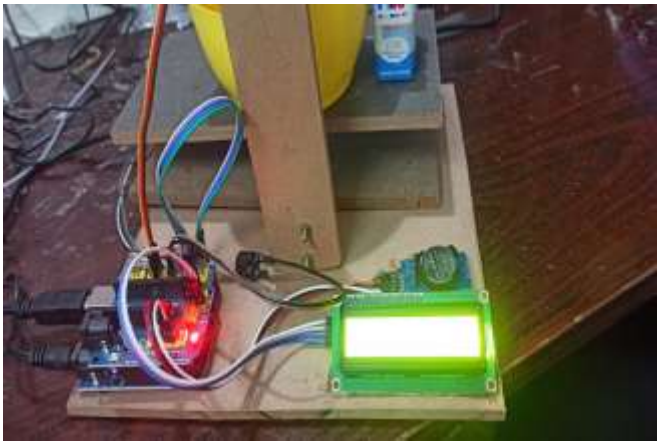
☞Portion Measurement: Load sensor checks the food weight to ensure correct portions.

☞ User Interface: LCD displays status, buzzer gives sound alerts.

☞ Pet Identification:PC with image processing identifies the pet before feeding.

☞Automation: The system runs automatically with minimal human input

V. RESULTS



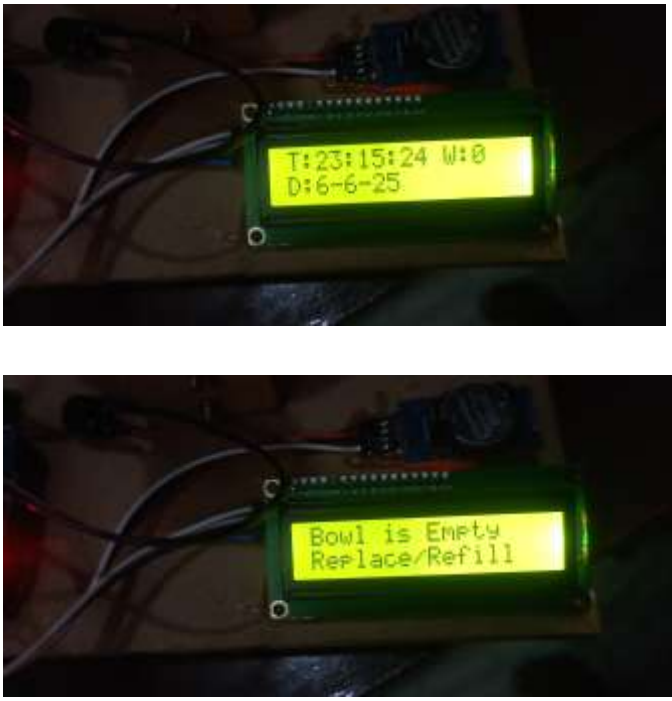


Fig :Final Output of Automatic Pet feeder Using Arduino

VI. FUTURE ENHANCEMENTS:

☞Mobile App Integration: Control and monitor feeding remotely using a smartphone app via Wi-Fi or Bluetooth.

☞Wi-Fi/IoT Connectivity: Send feeding logs and notifications to the owner's phone or email.

☞Voice Command Support:Integrate with voice assistants like Alexa or Google Assistant.

☞Pet Face Recognition: Use advanced image processing to recognize individual pets for personalized feeding.

☞Weight Monitoring of Pet: Add a platform to weigh the pet before/after feeding for health tracking.

☞Battery Backup System: Ensure continuous operation during power failures.

VII. CONCLUSION:

The designed automatic pet feeder using Arduino and PC-based image processing serves as a reliable solution to pet feeding challenges. It ensures scheduled and presence-based feeding with precise food quantity control. The integration of real-time clock, servo, and load sensor ensures a comprehensive and responsive system. Although dependent on an external PC for detection, the project remains an accessible and customizable solution for both home users and developers. With potential improvements like adding a camera module and embedded processing, the system can evolve into a standalone unit, enhancing flexibility and reliability. This solution demonstrates how embedded systems and AI can simplify daily tasks in the smart home era.

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