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IoT CONTROLLED FISH FEED ROBOT FOR SMART AQUA CULTURE

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ABSTRACT:

The IoT-Controlled Fish Feeding Robot is an automated system designed to facilitate efficient and precise fish feeding in aquaculture environments. The robot is equipped with two motors that enable forward, reverse, left, and right movement, allowing it to navigate across a fish pond.

Additionally, a dedicated seed motor is integrated to control the opening and closing mechanism for dispensing fish feed. The system is connected to an IoT-enabled Android application, enabling users to remotely control both the robot's movement and the feeding process. This automation minimizes manual effort, ensures timely feeding, and optimizes feed distribution, leading to improved fish health and reduced feed wastage. The implementation of IoT technology enhances accessibility and monitoring, making the system a cost-effective and smart solution for modern aquaculture management. This system proves especially useful for fish owners who may not always be present to feed their fish on time, such as during travel or busy work schedules. The IoT-based control allows users to monitor and adjust feeding times and quantities remotely, improving fish health and reducing food waste. The robot can be programmed for scheduled feeding or manually activated via an IoT interface. Furthermore, with real-time notifications and system feedback, users are informed of feeding status and any malfunctions. The combination of automation, remote access, and sensor feedback makes this project a reliable and smart solution for modern fish farming and pet care environments.

KEYWORD:

Fish Feeding Robot, Automated Feeding System, Smart Aquarium, Remote Control Feeding, Timer Based Feeder, Mobile App Control, Smart Fish Care, IoT Automation Real-Time Notifications.

1. Embedded Systems

An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today. Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites. (Each radar probably includes one or more embedded systems of its own.)

Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance.

Some embedded systems are mass-produced, benefiting from economies of scale. Physically embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

In general, "embedded system" is not a strictly definable term, as most systems have some element of extensibility or programmability. For example, handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them, but they allow different applications to be loaded and peripherals to be connected. Moreover, even systems which don't expose programmability as a primary feature generally need to support software updates.

2. Introduction:

2.1.1. Feeding Process:

Aquaculture is one of the fastest-growing food production industries worldwide, playing a crucial role in meeting the increasing demand for seafood. Proper feeding practices are essential for maintaining

healthy fish populations, maximizing growth rates, and minimizing feed wastage. Traditional manual feeding methods can be inefficient, labor-intensive, and inconsistent, leading to overfeeding or underfeeding. To address these challenges, automation in fish feeding has gained significant attention. This project, titled "IoT-Controlled Fish Feeding Robot," presents an innovative solution for automated fish feeding using Internet of Things (IoT) technology.

The IoT-Controlled Fish Feeding Robot is designed to operate autonomously, ensuring precise and controlled fish feeding. It is equipped with two motors that facilitate movement in multiple directions, including forward, reverse, left, and right, allowing the robot to navigate across a fish pond efficiently. Additionally, a dedicated seed motor is implemented to manage the opening and closing mechanism for dispensing fish feed. This system is integrated with an Android application, which enables users to remotely control the robot's movements and feeding operation via an IoT-based interface. This approach reduces human effort, optimizes feed utilization, and enhances overall efficiency in fish farming operations.

2.1.2. Need for an Automated Fish Feeding System:

Fish feeding is a critical factor that influences the health and growth of aquatic species. Traditional manual feeding methods have several limitations, including:

Inconsistency: Manual feeding may result in uneven distribution of feed, leading to underfeeding or overfeeding.

Labor Intensity: Requires continuous human intervention, making it time-consuming and costly.

Feed Wastage: Excess feed can lead to water contamination, affecting water quality and fish health record of student transportation activity.

2.2. System Overview

The fish feeding robot consists of the following key components:

Motors for Navigation: Two motors facilitate movement in four directions (forward, reverse, left, right), allowing the robot to reach designated feeding areas in the pond.

Seed Motor for Feeding Mechanism: Controls the dispensing of fish feed by opening and closing the seed container **Microcontroller Unit:** Serves as the brain of the robot, processing input commands from the user and controlling motor operations accordingly.

IoT Connectivity: The robot is connected to a cloud-based IoT platform that enables remote operation via an Android app.

Android Application: Provides an intuitive user interface for controlling the robot's movements and initiating the feeding process.

Power Supply: A rechargeable battery ensures uninterrupted operation of the robot.

3. Methodology

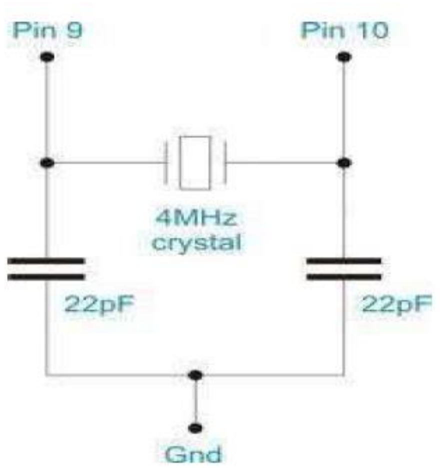
3.1. Hardware design

3.1.1. Arduino uno:

The Arduino Uno is a popular open-source microcontroller board based on the ATmega328P microcontroller. It's widely used for building interactive projects, prototypes, and proof-of-concepts. The board features 14 digital input/output pins, 6 analog inputs, a USB connection, and areset button. Arduino Uno is programmable using the Arduino IDE, making it accessible to beginners and experts alike. Its simplicity, flexibility, and extensive community support make it an ideal platform for various applications, including robotics, home automation, and IoT projects. In the context of the RFID-based system for school children transportation safety enhancement, Arduino Uno can serve as the microcontroller, processing data from RFID readers, GPS modules, and GSM modules to provide real- time tracking and notifications.

The AVR is a modified Harvard Architecture 8-bit RISC single chip microcontroller which was developed by Atmel in 1996. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to Onetime Programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time.

3.1.2. Crystal Oscillator:



XTAL1 and XTAL2 are input and output, respectively, of an inverting amplifier which can Crystal or a ceramic resonator may be used. The CKOPT Fuse selects between two different Oscillator amplifier modes. When CKOPT is programmed, the Oscillator output will oscillate a full rail-to-rail swing on the output. This mode is suitable when operating in a very noisy environment or when the output from XTAL2 drives a second clock buffer. This mode has a wide frequency range. When CKOPT is unprogrammed, the Oscillator has a smaller output swing. This reduces power consumption considerably.

This mode has a limited frequency range and it cannot be used to drive other clock buffers.

For resonators, the maximum frequency is 8 MHz with CKOPT unprogrammed and 16 MHz with CKOPT programmed. C1 and C2 should always be equal for both crystals and resonators. The optimal value of the capacitors depends on the crystal or resonator in use, the amount of stray capacitance, and the electromagnetic noise of the environment.

3.1.3. Wifi:

Wi-Fi (Short for Wireless Fidelity) is a wireless technology that uses radio frequency to transmit data through the air. Wi-Fi has initial speeds of 1mbps to 2mbps. Wi-Fi transmits data in the frequency band of 2.4 GHz. It implements the concept of frequency division multiplexing technology. Range of Wi-Fi technology is 40-300 feet. ESP8266 offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. When ESP8266 hosts the application, and when it is the only application processor in the device, it is able to boot up directly from an external flash. It has integrated cache to improve the performance of the system in such applications, and to minimize the memory requirements. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any microcontroller-based design with simple connectivity through UART interface or the CPU

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AHB bridge interface.

3.2. Software Description:

3.2.1 Arduino IDE:

Compiler

Here are currently two versions of the Arduino IDE, one is the IDE 1.x.x and the other is IDE 2.x. The IDE 2.x is new major release that is faster and even more powerful to the IDE 1.x.x. In addition to a more modern editor and a more responsive interface it includes advanced features to help users with their coding and debugging. The following steps can guide you with using the offline IDE (you can choose either IDE1.x.x or IDE 2.x):

1. Download and install the Arduino Software IDE:

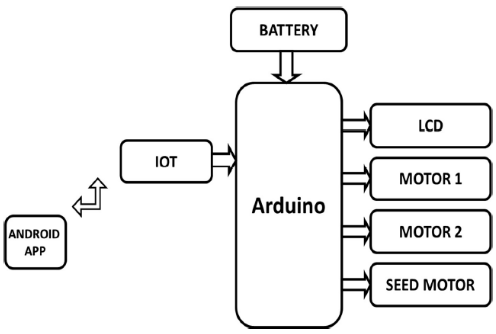
2. Arduino IDE 1.x.x (Windows, Mac OS, Linux, Portable IDE for Windows and Linux, ChromeOS).

3. Arduino IDE 2.x

4. Connect your Arduino board to your device.

5. Open the Arduino Software (IDE). transportation.

3.2.2 Block Diagram



WORKING PRINCIPLE:

The IoT-Controlled Fish Feeding Robot is designed to function seamlessly by following a structured process:

User Command: The user inputs commands through the Android application, selecting movement directions or activating the feeding mechanism.

Data Transmission via IoT: The commands are transmitted to the robot through an IoTenabled communication module (such as Wi-Fi or Bluetooth).

Robot Navigation:

The Microcontroller processes the commands and directs the motors accordingly, moving the robot within the pond.

Feed Dispensing: Upon reaching the desired feeding spot, the seed motor activates to release.

3.2.3 Proposed System

The proposed IoT-Controlled Fish Feeding Robot is designed to automate the fish feeding process while allowing remote control via an Android application over IoT. The system consists of a mobile robotic unit equipped with two DC motors for movement and a seed motor for dispensing fish feed. The integration of IoT technology enables real-time control and monitoring, making the feeding process more efficient and precise.

4. Conclusion and Future Scope:

The IoT-Controlled Fish Feeding Robot powered by Arduino Uno offers a smart, efficient, and automated solution for modern fish farming. By integrating robotic movement, IoT-based remote control, and a precise seed dispensing mechanism, the system optimizes fish feeding while reducing manual effort, feed wastage, and operational costs. The DC motor-driven movement system ensures controlled navigation across the pond, while the servo motor- controlled feed dispenser provides accurate and timely feeding. The IoT-enabled Android app allows farmers to operate the robot remotely, making fish feeding more convenient and reliable. Furthermore, the use of renewable energy sources like solar panels can enhance the

sustainability of the system, making it suitable for remote and off-grid fish farms. Compared to traditional feeding methods, this approach minimizes labor dependency, ensures better feed management, and improves overall fish health and growth. The proposed system is highly scalable, adaptable, and cost-effective, making it a valuable innovation for the aquaculture industry.

The IoT-controlled fish feed robot operates by dispensing feed at scheduled intervals or on demand, using a motorized mechanism controlled by a microcontroller. It connects to a mobile app or web dashboard through Wi-Fi or GSM, allowing farmers to monitor and control feeding remotely.

The future scope of an IoT-controlled fish feed robot is highly promising, especially in the context of modernizing aquaculture and promoting smart farming techniques. As the demand for efficient and sustainable fish farming grows, the integration of IoT technologies into feeding systems offers numerous advantages. These robots can significantly reduce labour costs, minimize human error, and optimize feed usage, leading to improved fish health and faster growth rates. In the future, these systems can be enhanced with AI-based fish behaviour analysis, allowing real-time adjustments to feeding patterns based on fish activity or hunger levels. Integration with cloud platforms will enable farmers to monitor multiple ponds remotely and analyse historical data for better decision-making. services.

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