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AUTONOMOUS FLOOR CLEANING ROBOT WITH WATER SPRINKLER

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Abstract: This floor cleaning robot, also known as a clean sweep robot, is equipped with a rotating cotton rope mop attached to a motorized mechanism. It autonomously navigates within walls, avoiding obstacles using IR sensors. It has three DC motors for movement and one for water sprinkling. A mini water tanker with a high-pressure pump sprays water intermittently. Control is managed by an 89c52 microcontroller. The system requires a high-power rechargeable battery.

***Index Terms* -** Floor cleaning robot, Autonomous navigation, Revolving cotton rope mop, IR sensors, High pressure water pumping motor.

I. INTRODUCTION

The project outlined here is a venture into the realm of autonomous household robotics, specifically focusing on designing a floor cleaning robot capable of wet mopping. The robot is equipped with sensors to detect obstacles, enabling it to navigate around a room without colliding with walls or objects. It incorporates a water sprinkling mechanism to moisten a revolving mop for effective cleaning.

This innovation represents a departure from traditional floor cleaning methods, offering a hands-free approach to maintaining cleanliness in homes. While robotic vacuum cleaners are already prevalent in the market, the addition of wet cleaning capabilities adds a new dimension to automated cleaning solutions.

The core of the system is an 89C52 Atmel microcontroller chip, serving as the main processing unit. Alongside IR sensors, trigger circuits, motors, and the mopping mechanism, the microcontroller orchestrates the robot's operations. Through programmed instructions, the microcontroller manages obstacle avoidance, collision detection, and the timing of water sprinkling.

The project's success hinges on the microcontroller's ability to interpret sensor data and execute predefined tasks. Microcontrollers have become indispensable in modern automation, facilitating precise control and coordination of complex systems. Understanding microcontroller-based systems is crucial for developing cutting-edge products that enhance efficiency and convenience in various domains.

The project underscores the significance of microcontrollers in driving technological advancements, particularly in the field of robotics and automation. As the backbone of such systems, microcontrollers enable seamless communication, precise control, and efficient operation, making them indispensable in modern instrumentation and control systems.

In summary, the autonomous floor cleaning robot project demonstrates the pivotal role of microcontrollers in realizing innovative solutions for household automation. By leveraging microcontroller technology, the project aims to simplify floor cleaning tasks and enhance the overall convenience and efficiency of domestic environments.

II. ANALYSIS OF OBSTACLE SENSING CIRCUIT

The obstacle sensing circuit utilizes IR sensors and the LM567 IC to detect obstacles in various directions, crucial for the autonomous navigation of the robotic vehicle. The LM567 IC acts as a tone decoder, generating frequencies based on received IR signals. A transistor amplifies the IC's signal to drive the IR transmitter effectively, while the IR receiver detects reflected signals, filtering out noise before feeding it into the IC. When an obstacle is detected, the IC outputs a logic low signal, triggering appropriate actions. This setup enables the vehicle to intelligently maneuver around obstacles, akin to human decision-making. The system provides visual feedback through an LED indicator, enhancing user interaction. Overall, this project embodies the synergy between technology and human-like decision-making, creating an efficient and reliable autonomous floor cleaning solution.

III. FUNCTIONAL DESCRIPTION OF MAIN PROCESSOR AND ITS ASSOCIATED DEVICES

Based on the detailed description provided, it seems that you are working on a project involving the development of an autonomous floor cleaning robot using an 89C52 microcontroller chip. Here's a summary and breakdown of the key components and functions described:

1. Water Sprinkling Mechanism:

- The water sprinkling mechanism involves a small water tank attached to the moving mechanism of the robot.
- A mini high-pressure water pumping motor is permanently attached to the water tank.
- A small copper pipe with a tiny hole is directed towards the mop to wet it when the pumping motor is energized.
- The pumping motor is activated automatically for a second at fixed intervals of 30 seconds while the moving mechanism is stopped.

2. Rechargeable Battery:

- A 12V, 3AH lead-acid rechargeable battery is used to power the system.
- The battery requires periodic charging, especially during idle conditions, to maintain its charge.
- The back-up time of the battery is approximately 1.5 hours considering a continuous current consumption of nearly 2Amps by the system.

3. Mechanism and H-Bridge IC:

- The robot's movement mechanism involves a combination of mechanical, electrical, and electronic components.
- The motor driving circuit utilizes an L293D H-bridge chip to drive the low-power DC motors.
- The microcontroller controls the H-bridge to drive the motors in both directions.

4. Battery Charging:

- Charging the battery is done using an unregulated charger designed to utilize the main power source.
- The battery terminal voltage should not exceed 13.5V during charging to prevent damage.
- The charging time depends on the battery rating and the charging current.

5. Relay:

- A relay is used to control the supply to the water pumping motor.
- Relays are electromechanical switches used to make or break electrical connections based on control signals.

6. Main Processing Unit - 89C52 Microcontroller:

- The core processing unit is an ATMEL 89C52 microcontroller chip.
- The microcontroller is programmed to monitor sensors continuously and control the actions of the system accordingly.
- It is based on the 8051 family architecture, featuring an 8-bit CPU with various peripherals such as timers, serial ports, and GPIO pins.

7. Memory and Architecture:

- The microcontroller has internal ROM (4K bytes) and RAM (128 bytes) for program and data storage.
- It features four register banks, timers/counters, serial communication, and interrupt handling capabilities.
- The microcontroller operates based on the Harvard architecture, separating program and data memory for increased reliability.

8. Applications and Advantages:

- Microcontrollers like the 89C52 are widely used in embedded systems for their ability to control devices and perform specific tasks.
- They offer a cost-effective solution with low power consumption and dedicated functionality.
- The 8051 family of microcontrollers provides flexibility and ease of programming for a variety of applications.

In summary, the project involves integrating various technologies to develop an autonomous floor cleaning robot controlled by an 89C52 microcontroller chip. The system incorporates mechanical, electrical, and electronic components to achieve its functionality, with the microcontroller serving as the central processing unit for sensor monitoring and control**.**

IV. DESCRIPTION OF 89C51/52 AND THE 89C51 OSCILLATOR AND CLOCK:

The evolution of microcontrollers and microprocessors began with the development of integrated circuits, condensing transistors onto single chips. This led to the birth of microprocessors, initially requiring external peripherals. In 1971, Intel introduced the groundbreaking 4004, the first 4-bit microprocessor. Subsequent advancements like the 8008 and 8080 followed, with competitors such as Motorola and MOS Technology entering the market. Zilog Inc., founded by Frederico Faggin, introduced the Z80 in 1976, renowned for its compatibility and features. Despite Intel's efforts with the 8085, the Z80 remained dominant, alongside the MOS Technology 6502. This narrative highlights key contributors and their innovations, showcasing the competitive landscape of the industry and its transformative impact on modern computing.

4.1 Microcontroller versus Microprocessor

Microcontrollers and microprocessors have distinct differences that affect their functionality. While a microprocessor requires additional components like memory to function, a microcontroller is designed to integrate all necessary circuits, including those for communicating with peripheral equipment, onto a single chip. This integration saves time and space in device design.

Unlike microprocessors, which rely on external chips for communication with peripheral devices, microcontrollers have built-in interfaces such as serial ports, parallel ports, timers, counters, and interrupt controllers. This means that a microcontroller combines a powerful CPU with memory and various I/O interfaces on a single silicon chip, eliminating the need for external components like RAM and ROM.

One significant difference is that microcontrollers often handle bits rather than bytes in real-world applications. For example, Intel's MCS-51 family of microcontrollers offers features like in-system reprogrammable flash memory, programmable clock, timer/counters, interrupt sources, and a programmable serial channel. These features make microcontrollers compatible with a wide range of applications and reduce the size and cost of device design compared to using a microprocessor.

4.2 WHY AT 89C51?

The usage of 16, 32, or 64 bit micro controllers or microprocessors is expressly prohibited by the system requirements and control specifications. Because of their many internal characteristics, systems that use them might have been implemented earlier. Although they are also more dependable and speedier, an 8-bit microcontroller is sufficient for the aforementioned application. In any competitive market, using a cheap 8-bit microcontroller will be the death knell for the 32-bit device.

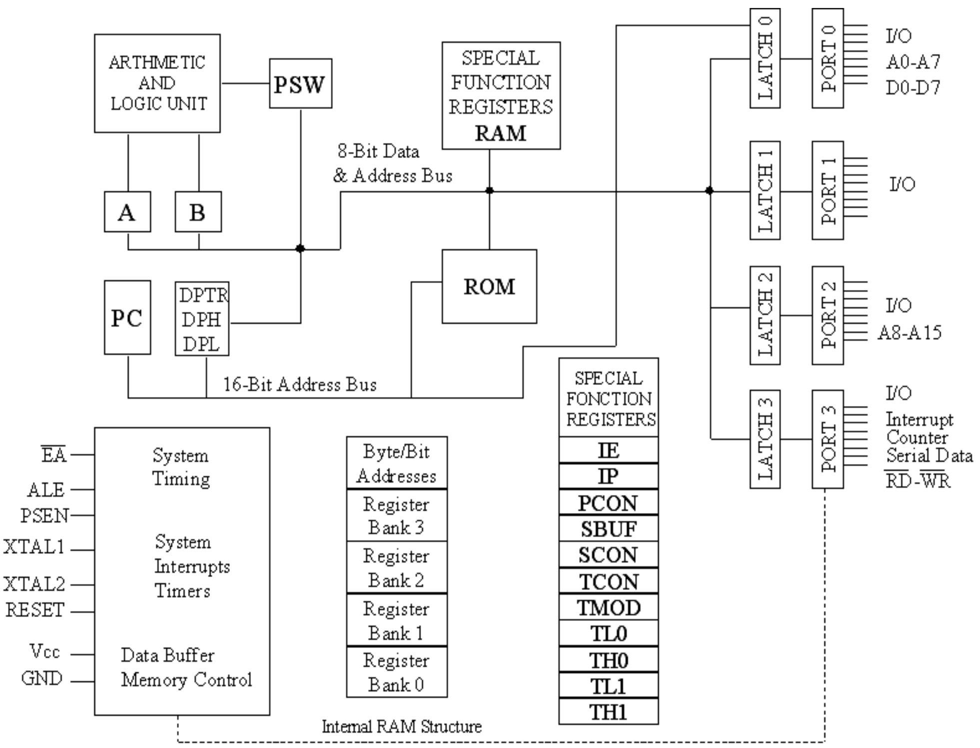
When considering which 8-bit microcontroller to choose from the market, the AT89C51 is a good choice because its 4 Kb of on-chip flash memory is more than enough for our needs. Reprogramming the system's program memory is possible thanks to the on-chip Flash ROM.

4.3 AT89C51 MICROCONTROLLER ARCHITECTURE

The following particular features make up the 89C51 architecture:

- Registers A (the accumulator) and B on an eight-bit CPU
- Eight-bit stack pointer (PSW)
- Eight-bit stack pointer (Sp)
- Sixteen-bit program counter (PC) and data pointer (DPTR)
- Internal EPROM (8751) or ROM, ranging from 0 (8031) to 4K (89C51).
- 32 input/output pins organized into 4 8-bit ports (p0-p3)
- SBUF is a full duplex serial data receiver/transmitter.
- T0 and T1, two 16-bit timer/counters
- TCON, TMOD, SCON, PCON, IP, and IE are the control registers.
- Three internal and two external sources of interruptions.
- Circuits for oscillators and clocks

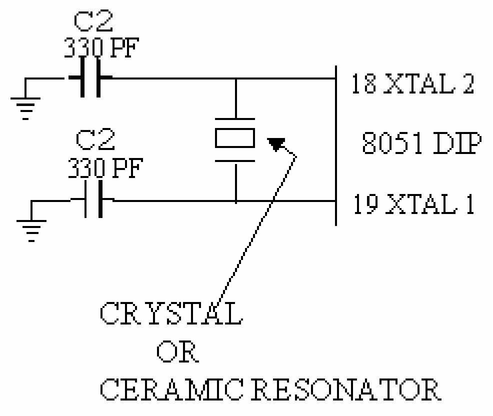
BLOCK DIAGRAM

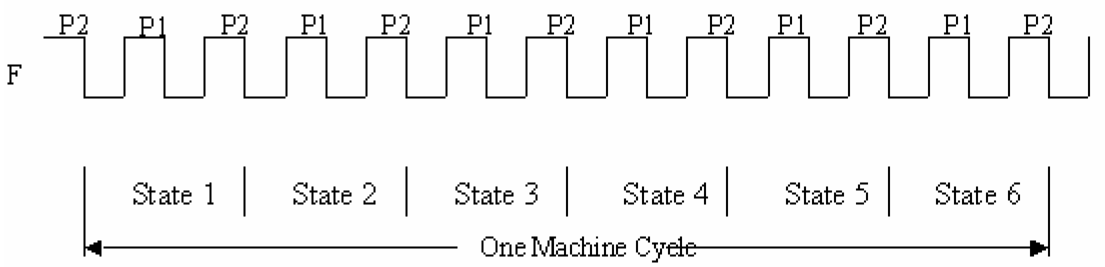


functional block diagram of microcontroller

4.4 THE 89C51 OSCILLATOR AND CLOCK:

This is the main component of the circuitry that powers the 89C51 and produces the clock pulses that synchronize all internal processes. An oscillator can be formed by connecting a resonant network through pins XTAL1 and XTAL2. Usually, capacitors and a quartz crystal are used. The microcontroller's fundamental internal clock frequency is known as the crystal frequency. The 89C51 designs that are produced by the manufacturers operate at precise minimum and maximum frequencies, usually between 1 and 16 MHz.





Oscillator and timing circuit

4.5 TYPES OF MEMORY:

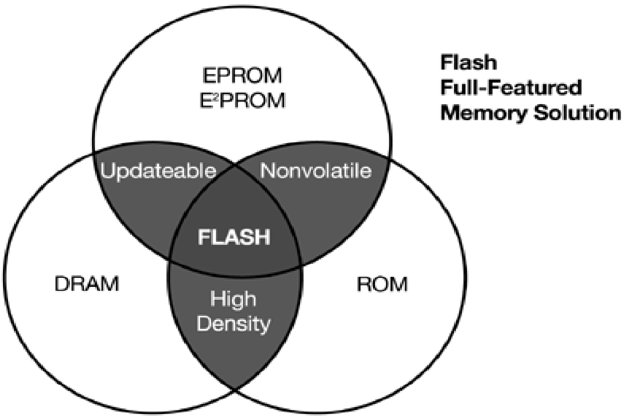
The 89C51 have three general types of memory. They are on-chip memory, external Code memory and external Ram. On-Chip memory refers to physically existing memory on the micro controller itself. External code memory is the code memory that resides off chip. This is often in the form of an external EPROM. External RAM is the Ram that resides off chip. This often is in the form of standard static RAM or flash RAM

4.6 FLASH MEMORY

Flash memory, also known as flash RAM, is a type of non-volatile memory that retains data even when power is removed. It can be erased and reprogrammed in blocks, unlike electrically erasable programmable read-only memory (EEPROM), which operates at the byte level and is slower to update. Flash memory is commonly utilized to store control code like the basic input/output system (BIOS) in personal computers, allowing for easy updating by writing to memory blocks instead of individual bytes. However, it is not suitable for random access memory (RAM) as RAM requires byte-level addressing.

The term "flash" refers to the memory chip's ability to erase a section of memory cells in a single action. This erasure is facilitated by Fowler-Nordheim tunneling, where electrons pass through a thin dielectric material to remove an electronic charge from a floating gate associated with each memory cell. Intel has developed a type of flash memory that stores two bits in each cell, effectively doubling memory capacity without increasing costs.

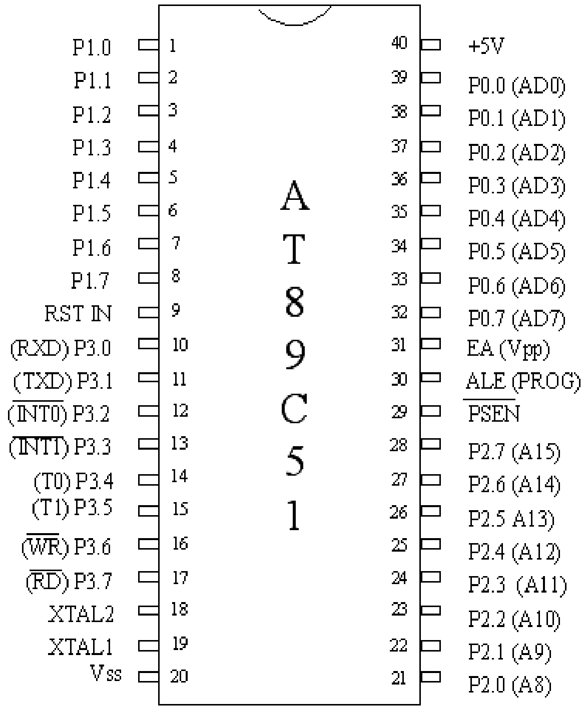
Flash memory finds applications in various devices such as digital cellular phones, digital cameras, LAN switches, notebook computer PC Cards, digital set-top boxes, embedded controllers, and more.



Memory Type	Features
FLASH	Low-cost, high-density, high-speed architecture; low power; high reliability
ROM Read-Only Memory	Mature, high-density, reliable, low cost; time-consuming mask required, suitable for high production with stable code
SRAM Static Random-Access Memory	Highest speed, high-power, low-density memory; limited density drives up cost
EPROM Electrically Programmable Read-Only Memory	High-density memory; must be exposed to ultraviolet light for erasure
EEPROMorE^{2}PROM Electrically Erasable Programmable Read-Only Memory **Dram; Dynamic Random Access Memory**	Electrically byte-erasable; lower reliability, higher cost, lowest density

Technical Overview of Flash Memory

The ability to electrically program and erase data is provided by flash memory, a non-volatile memory utilizing NOR technology. Similar to an EPROM, Intel® Flash memory employs memory cells with a considerably thinner, carefully produced oxide positioned between the floating gate and the source (refer to Figure 2). Placing electrons on the floating gate causes flash programming. The oxide layer permits the cell to be electrically erased through the source, storing the charge on the floating gate. The non-volatile memory design of Intel Flash memory is incredibly dependable.



Pin Diagram of AT89C51:

VCC: Provides the supply voltage.
GND: Connected to ground.

Port 0:
Port 0 is an 8-bit bi-directional I/O port with open-drain output. It can sink TTL inputs when used as an output. Writing 1s to Port 0 pins configures them as high impedance inputs. Port 0 can also function as the low order address/data bus during external memory accesses, with internal pull-ups activated in this mode. During Flash programming, Port 0 receives code bytes and outputs them during verification, requiring external pull-ups.

Port 1:
Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. Its output buffers can sink/source four TTL inputs. Writing 1s to Port 1 pins activates the internal pull-ups, allowing them to be used as inputs. When externally pulled low, Port 1 pins source current. During Flash programming, Port 1 receives low-order address bytes.

Port 2:
Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. Its output buffers can sink/source four TTL inputs. Writing 1s to Port 2 pins activates the internal pull-ups, allowing them to be used as inputs. Port 2 emits the high-order address byte during external program memory fetches and 16-bit address accesses to external data memories. During Flash programming, it receives high-order address bits and control signals.

Port 3:
Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. Its output buffers can sink/source four TTL inputs. Writing 1s to Port 3 pins activates the internal pull-ups, allowing them to be used as inputs. Port 3 serves various special features of the AT89C51, including receiving control signals for Flash programming and verification.

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{\text{INT0}}$ (external interrupt 0)
P3.3	$\overline{\text{INT1}}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{\text{WR}}$ (external data memory write strobe)
P3.7	$\overline{\text{RD}}$ (external data memory read strobe)

Port 3 pins and their alternate functions

V. MINI WATER PUMPING MOTORS AND SOFTWARE DESCRIPTION

DC powered pumps, including mini submersible water pumps, utilize direct current from various sources such as motors, batteries, or solar panels. They typically operate on voltages like 6V, 12V, 24V, or 32V. Mini submersible pumps, which are centrifugal in nature, use a motor to drive an impeller, pushing water outward. They are designed to be fully submerged, making them ideal for tasks like drainage, sewerage pumping, or aquarium filtration. These pumps are lightweight, compact, and consume low energy, making them suitable for household applications like cooking, cleaning, and watering plants. Despite their advantages, they may suffer from seal corrosion over time, potentially damaging the motor. Overall, mini submersible pumps offer efficient water movement with minimal noise and are widely used in various domestic and industrial settings.

5.1 HOW THE IMPELLER WORKS?

A mini submersible water pump utilizes a centrifugal mechanism, driven by a motor and impeller, to pump water. The impeller's rapid rotation channels water into the center and along its outer blades. This movement creates centrifugal force, compressing the water against the blades and causing it to jet forward at high speed. The resulting pressure pushes the water through the pump outlet, facilitating efficient water movement.

5.2 HOW DOES THE MOTOR WORK?

The motor of a mini submersible water pump operates through electromagnetic induction, with coils and magnets generating a magnetic field to spin the rotor. This rotation, transmitted via a gear drive, powers the impeller, which pumps water through centrifugal force. These pumps are commonly used in household settings for tasks like draining water tanks or aquariums due to their efficiency and quiet operation. Additionally, pumps in general play crucial roles across various industries, from water-cooling in cars to medical applications like artificial heart implants. Positive-displacement pumps, another type, maintain a constant flow rate regardless of pressure, while centrifugal pumps, like mini submersibles, change the fluid's direction by 90 degrees. Compressed-air-powered double-diaphragm pumps are a modern example of positive-displacement pumps, offering safety and versatility in various applications.

5.3 SOFTWARE DESCRIPTION

Developing software and hardware for microcontroller-based embedded systems requires a range of tools, including editors, assemblers, compilers, debuggers, simulators, emulators, and Flash/OTP programmers. For those new to microcontroller development, understanding how these tools collaborate in the development cycle is crucial.

The fundamental steps in the microcontroller development cycle are as follows:

1. Crafting Microcontroller Code: Typically, developers write code for a microcontroller using languages like assembler or C. Assembler code is tailored to the microcontroller's instruction set, resulting in efficient and swift code execution. Conversely, C provides portability but may lead to larger code sizes.

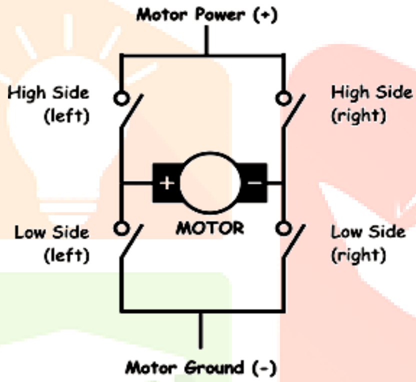
2. Code Translation: The written source code must undergo translation into instructions that the microcontroller can execute. These instructions, known as op codes, are represented in hexadecimal format, with each hex number representing 4 bits within a byte. The resulting firmware, in a machine-readable format, is commonly referred to as Hex-Code, with the file storing it termed a Hex-File.

3. Debugging: After translation, the code must undergo debugging to ensure proper functionality and address any encountered errors.

In essence, the development process entails writing code in a programming language, translating it into machine readable instructions, and debugging to verify proper operation.

VI. DESCRIPTION OF H BRIDGE IC, DESCRIPTION OF TIMER CHIP AND HARDWARE DETAILS

Robotics hobbyists often choose between DC motors and stepper motors, with DC motors preferred for their speed, weight, size, and cost advantages. DC motors offer versatility when connected to a microcontroller, enabling precise control over speed, direction, and rotation encoding. Interfacing DC motors commonly involves using the L293D H-bridge motor driver IC for its compact size and ease of use. The L293D typically includes two H-bridges, facilitating simultaneous control of two DC motors. Understanding H-bridge theory is essential for effectively utilizing devices like the L293D.



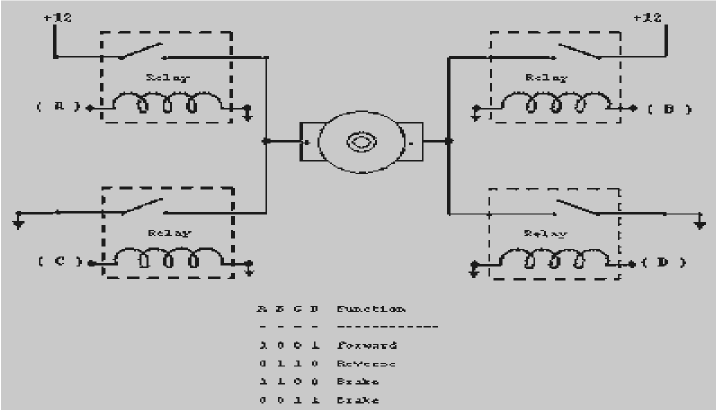
The H-bridge configuration resembles an "H" shape, comprising four switching elements positioned at the corners, facilitating current control. Diagonally opposed switches are activated to power the motor, initiating rotation in one direction. Reversing direction involves toggling these switches. The choice of switches varies from SPST switches to power MOSFETs. Quadrants enable various operational modes, with four useful states out of 16 possible ones to avoid short circuits.

High Side Left	High Side Right	Low Side Left	Low Side Right	Quadrant Description
On	Off	Off	On	Forward Running
Off	On	On	Off	Backward Running
On	On	Off	Off	Braking
Off	Off	On	On	Braking

The final two rows of the above table explain a short circuit circumstance that makes the motor's generator effect oppose itself. A voltage is produced by the turning motor in an attempt to make it turn in the opposite direction. This is referred to as "braking" on many H-bridge designs and causes the engine to cease spinning quickly. Naturally, there is also the situation in which no transistors are present. In this instance, the motor does nothing while it is not spinning and coasts easily when it is.

1.Using Relays:
Four SPST relays are used to create a basic H Bridge implementation. Terminals B, C, and D are High Side Left, Low Side Left, and Low Side Right, respectively. Terminal A is High Side Left. The preceding table provides the reasoning that was used.

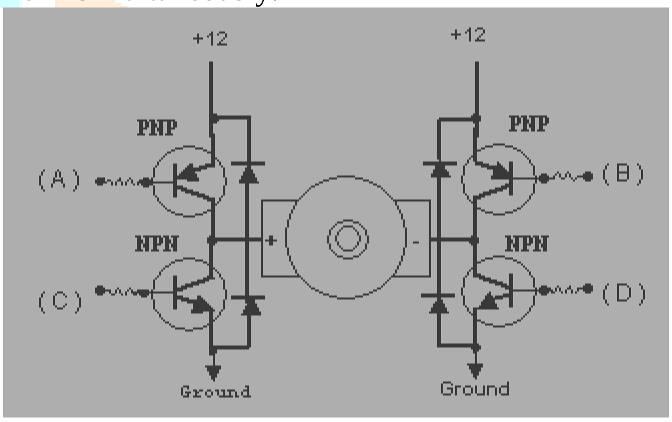
Caution: don't turn on A and C or B and D simultaneously. This will cause the battery to short circuit, and the excessive current will cause the relays to fail.



2.Using Transistors:

Field Effect Transistors (FETs) are a type of transistor that we can use to better control our motor. The majority of our discussion regarding H-Bridge relays applies to these circuits. View the diagram that illustrates their relationship. To capture the back voltage that the motor's coil generates when the power is turned on and off, we should place diodes across the transistors. The flyback voltage has the potential to exceed the supply voltage by several times.

Never turn on A and C or B and D simultaneously.



MOSFETs offer superior efficiency to transistors, handling higher currents with less heat generation. P-Channel MOSFETs source power, while N-Channel MOSFETs sink it in H-bridge setups, crucial for bidirectional motor control. H-bridge chips like the L293D simplify motor control, capable of driving two DC motors bidirectionally or four motors unidirectionally. The L293D requires dual power supplies, Vcc1 for logic and Vcc2 for the output circuit, with a voltage range of 4.5V to 36V for Vcc2. Each half H-bridge has individual ground connections, and enable pins activate them according to a specific truth table.

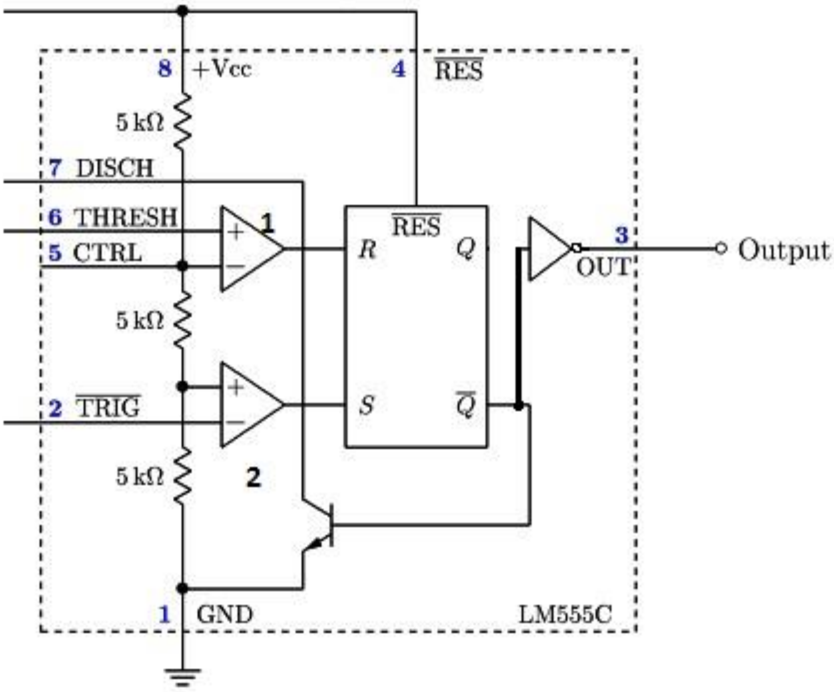
INPUT A	OUTPUT Y
L	L
H	H

Thus, all we have to do is provide a High level to activate the Half H-Bridge and a Low level to deactivate it. The voltage at the output is equal to Vcc2 when the Half H-Bridge is turned on. The motor (or load) must be connected between the outputs of two Half H-Bridges, and the two Half H-Bridge inputs will be the inputs, in order to create a Full H-Bridge.

6.1 Description of timer chip

The 555 timer chip serves as a circuit isolator in this project, separating the microcontroller from the water pumping motor to prevent electric noise generated by the motor from affecting the processor. The circuit utilizes an LDR (Light Dependant Resistor) and a light source to create electrical isolation. When the light source energizes, its intensity falls on the surface of the LDR, decreasing its resistance. Configured in Schmitt trigger mode, the timer chip triggers at 1/3 Vcc and 2/3 Vcc based on the light intensity detected by the LDR.

The timer chip controls the water pumping motor through a relay, energizing it for 1 second at intervals of 30 seconds during the floor cleaning mechanism. The IC 555 timer, named after its three 5 kilo-ohm resistors in series, is widely used in electronics for its stability and versatility. It functions as a square-wave form generator with adjustable duty cycle, an oscillator, and provides time delay in circuits. Available in various package options, including the 556 dual version and the 558 quadruple timer, the 555 timer chip is a fundamental component in electronic circuits.



Pin Diagram of 555 IC

The 555 timer chip is a versatile component used in various electronic circuits for different purposes. Here's a summary of its basic concepts, functions of different pins, and uses:

Basic Concepts:

- Comparator: Provides a high signal if the non-inverting input is larger than the inverting input after comparing two input voltages (inverting and non-inverting).
The input resistance of an ideal comparator is infinite.

- Voltage Divider: Produces Vin/3 across each resistor by dividing the input voltage equally across the three resistors.

- Flip/Flop: A digital electronics memory component. When input at 'S' is high and 'R' is low, output (Q) is high; conversely, when input at 'S' is low and 'R' is high, output (Q) is low.

Function of Different Pins:

1. **Ground:** Provides zero voltage rail to the IC.
2. **Trigger:** Sets the output of the flip/flop to high state by applying voltage equal to or less than Vin/3.
3. **Output:** Output pin of the IC, connected to Q' (complementary output) of the flip/flop.
4. **Reset:** Resets the output of the flip/flop regardless of its initial condition.
5. **Control Voltage:** Overrides the inverting voltage to change the width of the output signal.
6. **Threshold:** Connected to the non-inverting input of the first comparator, resets the output of the flip/flop from high to low.
7. **Discharge:** Discharges the timing capacitors to ground when Pin 3 output is low.
8. **Supply:** Provides supply voltage to the IC for its functioning.

The 555 timer chip is essential in electronics for its ability to generate precise timing pulses and oscillations, making it a fundamental component in many circuits.

6.2 Hardware details

In the practical implementation of any project, gathering suitable hardware components is crucial for the successful demonstration of the described model. Here's a summary of the necessary hardware components for this project:

In this project, microcontroller chips serve as the processing unit, controlling components via firmware and software instructions. Sensors detect physical quantities or environmental conditions, providing input for decision-making. Control circuits, including motors, relays, and switching devices, manage system operations. LCD displays, although not utilized here, are common for monitoring performance. Hardware encompasses physical system components, while firmware directly controls operation, and software interfaces with the system. Components are essential internal devices, while peripherals enhance system capabilities but aren't core functions.

The active components utilized in this project work are listed below.

1. One microcontroller chip, the 89C52
2. IC 567, part two
3. The regulator of voltage
4. Relay
5. DC motor number five
6. H Bridge IC L293D
7. IC 555
8. LDR

VII. RESULTS

We've crafted a robotic wet mopping floor cleaner that's designed to operate autonomously, freeing users from the need for human intervention. This innovative cleaning system integrates sensors and robotic drives, along with a programmable controller and a revolving mopping tool, enabling it to efficiently navigate within enclosed spaces without colliding with walls. Originally designed to be operated manually via remote control, we've since enhanced it with a "self-drive" mode, allowing it to clean independently.

Our initial model focuses on the fundamental features of a wet mopping robot, incorporating a water sprinkler system. This simplicity ensures ease of use while maintaining autonomy in cleaning tasks. However, it's important to note that while these devices offer convenience, they may not match the effectiveness of human cleaners due to their reliance on sensors. As a prototype, it's not yet a fully optimized mechanism, and precise adjustments are necessary to transform it into a practical working system. We're committed to refining and enhancing its capabilities in our future endeavors based on the results and feedback we've garnered thus far**.**

VIII. CONCLUSIONS

The robotic wet mopping floor cleaner described here is designed to operate autonomously, eliminating the need for human intervention. Equipped with sensors and robotic drives controlled by a programmable controller, it navigates within the confines of four walls without colliding with obstacles. Originally designed for manual operation via remote control, it has been modified to operate in "self-drive" mode, enabling autonomous cleaning.

The system's main advantages include ease of use and autonomous operation. However, it's important to note that while autonomous robotic cleaners offer convenience, they may not always be as effective as human cleaners due to their reliance on sensors. As a prototype model, this floor mopping system serves as a basic version with a water sprinkler, earning it the title of a wet mopping robot.

While the perception of such devices as set-and-forget solutions is common, it's essential to recognize that they may require accurate modifications to optimize performance. Future work will focus on implementing necessary adjustments to enhance the system's functionality. Despite being a prototype, the constructed model has yielded satisfactory results.

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