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A 360-Degree Navigation System Using a Novel Mean-Based Algorithm

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ABSTRACT:

Building and testing a pathfinding algorithm on a test RC vehicle with a single ultrasonic sensor is the main focus of our research. Normal and intense detection are the two halves of the method. An accurate way to find a route devoid of obstacles is given by this algorithm. By using a servo motor to expand the sensor's field of view, the intense detection approach is able to create an omnidirectional composite sensor from a single monodirectional sensor. It takes a mean-based approach to reducing the amount of possible false positives for the optimum route. Hyper-W 130 MotorShield, Servo Motor, Ultrasonic Sensor, Arduino UNO, and DC Motors are some of the index terms.

INTRODUCTION

Nowadays, pathfinding algorithms are crucial for automation and robotics. The one-way nature of ultrasonic sensors limits the pathfinding algorithms that are often utilized with these devices. They make the mistake of relying on the simplistic left-or-right directional judgments [1]. Improved algorithms are the focus of this work. In order for the vehicle to discover routes and avoid obstacles, these algorithms are vital. In the military, they may be used for a variety of purposes, including accessing hazardous or inaccessible places. Additionally, they may be used in atmospheric alien obstacle avoidance systems.

Motivation

Problems caused by the ultrasonic sensor's inability to detect in both directions inspired this idea. Because it produces false positives, this method (explained in the Algorithm section), does not provide a reliable means of determining the idealpath. Other wide-angle approaches do exist, but they are often rather complex and costly. Our inspiration for the composite sensor came from this need; it consists of an ultrasonic sensor attached to a Servo motor. In conjunction with this sensor, we developed an algorithm for omnidirectional pathfinding and obstacle identification.

Paper Organization

A brief summary of our project will be provided in Section II, which details the hardware and design. Figure 1. Requirements for the Circuit Diagram. The algorithm and its operation are then described in Section III. The software need and control method will be described in Section IV, with an emphasis on their crucial function. Section VI will give a comprehensive synopsis of our findings and contributions, while Section V informs us about the project's benefits, practical uses, and future prospects. Figure 12 shows the block diagram, whereas Figure 13 shows the finished model. Our main approach is based on omnidirectional pathfinding with a single ultrasonic sensor and a mean-based algorithm.

BLOCK DIAGRAM

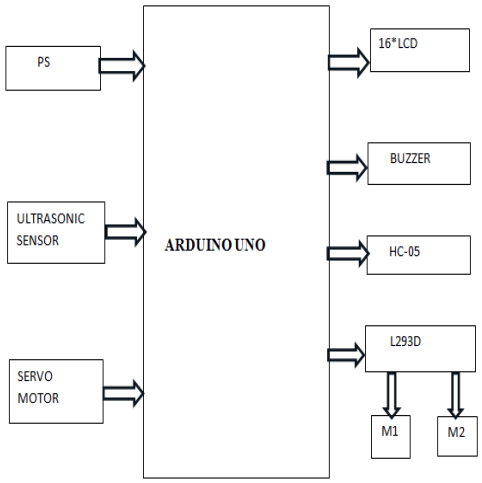


Figure: 1 Block Diagram

INTRODUCTION TO EMBEDDED SYSTEMS

A computer system that is purpose-built to carry out a single or limited set of tasks, often under the restrictions of real-time computing, is known as an embedded system. As with other physical and

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mechanical components, it is often integrated into a whole device. A personal computer or other general-purpose computer, on the other hand, may be programmed to do a wide variety of functions. These days, many of the everyday items we use rely on embedded systems to function. Design engineers may improve the embedded system to decrease product size and cost while boosting reliability and performance since it is devoted to certain functions. Because of their mass production, certain embedded systems are able to take advantage of cost savings. From small, handheld devices like digital watches and MP3 players to massive, permanently installed systems like those controlling nuclear power plants, traffic lights, and factory controllers are all examples of physically embedded systems. From simple systems using a single microcontroller chip to complex systems housing several modules, peripherals, and networks in a massive chassis or enclosure, complexity may range greatly. The phrase "embedded system" lacks a precise definition because the majority of systems have programmability in some form. While they share some components with embedded systems, such operating systems and microprocessors, handheld computers are not technically embedded systems as they enable the loading of multiple programs and the connection of peripherals. Computer hardware and software, either fixed in capability or programmable, particularly intended for a certain sort of application device—this is what's called an embedded system. Embedded systems may be found in a wide variety of objects, including but not limited to: vehicles, medical devices, cameras, home appliances, aircraft, vending machines, toys, and, of course, cellular phones and personal digital assistants. A programming interface is given to programmable embedded devices, and programming for embedded systems is a niche field in and of itself. Embedded Java and Windows XP Embedded are two examples of embedded-specific operating systems and language platforms. On the other hand, certain budget consumer goods include integrated application and operating system components, employ very cheap microprocessors, and have limited storage space. Instead of being loaded into RAM (random access memory), as applications on personal computers are, in this situation the program is written permanently into the system's memory.

CHARACTERISTIC OF EMBEDDED SYSTEM

- Speed (bytes/sec): Should be high speed
- Power (watts): Low power dissipation
- Size and weight: As far as possible small in size and low weight
- Accuracy (%error): Must be very accurate
- Adaptability: High adaptability and accessibility
- Reliability: Must be reliable over a long period of time

APPLICATIONS OF EMBEDDED SYSTEMS

Here, in the Embedded World, we are living. The smooth operation of the various embedded goods that surround you is crucial to your day-to-day existence. In your living room, you have a TV, radio, and CD player; in your kitchen, you have a washing machine or microwave oven; and at your office, you have card readers, access controllers, and palm devices that let you do a lot. In addition to all of this, your automobile has a plethora of built-in controls that handle functions between the bumpers, most of which you probably don't give a second thought to.

- **Robotics:** industrial robots, machine tools, Robocop soccer robots
- **Automotive:** cars, trucks, trains
- **Aviation:** airplanes, helicopters
- Home and Building Automation
- **Aerospace:** rockets, satellites
- **Energy systems:** windmills, nuclear plants
- **Medical systems:** prostheses, revalidation machine.

MICROCONTROLLER VERSUS MICROPROCESSOR

When comparing microprocessors and microcontrollers, what are the key differences? Any general-purpose microprocessor, such an 8086, 80286, 80386, 80486, or a Pentium from Intel, or a 680X0 from Motorola, etc., is considered a microprocessor. In addition to lacking on-chip I/O ports, these microprocessors also lack random-access memory (RAM). Because of this, they are often called general-purpose microprocessors. Designing a working system around a general-purpose CPU like the 68040 or Pentium requires the addition of extra components like as RAM, ROM, I/O ports, and timers. Though these systems are more costly and cumbersome due to the inclusion of external RAM, ROM, and I/O ports, they provide the benefit of being versatile in that the designer may choose the quantity of RAM,

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ROM, and I/O ports required for the work at hand. Microcontrollers are an exception to this rule. On a single chip, you'll find a microprocessor, random access memory (RAM), read/write (ROM), input/output (I/O) ports, and a timer in a microcontroller. So, since the CPU, random access memory (RAM), read/write memory (ROM), input/output (I/O) ports, and timer are all integrated into a single chip, the designer is unable to include any more memory, I/O ports, or timer into the product. When space and cost are at a premium, microcontrollers are the way to go because of their set quantity of on-chip ROM, RAM, and output ports. I/O operations to read signals and switch on and off bits are often all that's needed in situations where a 486 or even an 8086 CPU isn't necessary, such as a TV remote control.

MICROCONTROLLERS FOR EMBEDDED SYSTEMS

The word "Embedded System" appears often in articles on microprocessors. The embedded system products heavily use microprocessors and microcontrollers. The microprocessor (or microcontroller) in an embedded system product is designed to do a single job exclusively. An embedded system is best shown by a printer since its central processing unit (CPU) is dedicated to a single function: data retrieval and printing. Take a Pentium based PC as an example. Word processors, print servers, bank teller terminals, video game consoles, network servers, and Internet terminals are just a few of the many uses for personal computers. A wide range of apps may have their software loaded and executed. Obviously, a computer's random access memory (RAM) and operating system are what allow it to execute applications and do all those other things. This robot's fire sensor sends a signal to the microcontroller the second it detects fire. One piece of application software is usually burnt into ROM in an embedded device. Many different embedded goods, such a keyboard, printer, modem, disk controller, sound card, CD-ROM drive, mouse, and so on, are either built into or attached to an x86 PC. A single-purpose microcontroller is housed inside each of these peripherals.

ARDUINO UNO BOARD:

One board that uses the Atmega328 microprocessor is the Arduino Uno. A 16 MHz ceramic resonator, 6 analog inputs, 14 digital I/O pins (including 6 PWM outputs), 1 USB port, 1 power connector, 1 ICSP header, and 1 reset button are all part of it. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

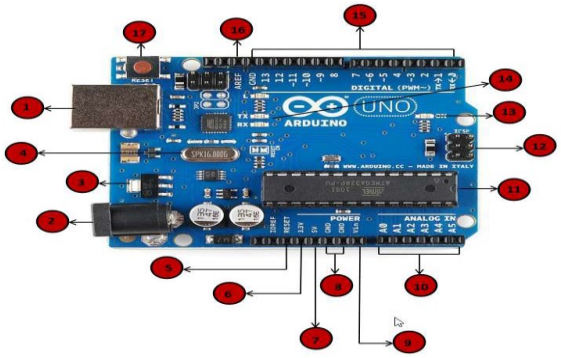


Figure 2 : Arduino uno board

HARDWARE COMPONENTS

POWER SUPPLY UNIT

The power supply for this system is shown below.

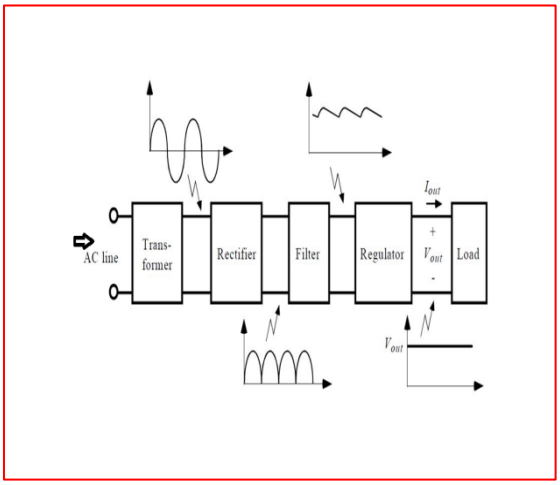


Figure 3.power supply

Diodes:

Only one path of electrical current may pass through a diode. Current can flow in either direction, as indicated by the arrow in the circuit symbol. Originally termed valves, diodes are essentially an electrically enhanced version of the mechanical component.

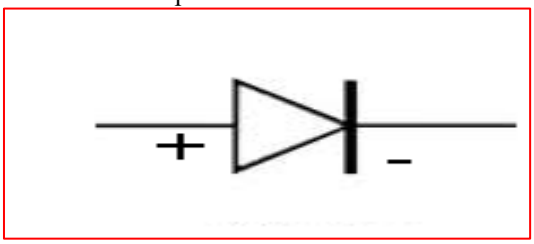


Figure 4. Diode Symbol

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One kind of electrical component that restricts current flow is the diode. A voltage loss of around 0.7V will be the sole influence on the signal when the diode is "forward-biased" in this way. No current will flow through a diode that is "reverse-biased" when the current is applied in the other direction.

Rectifier

Transform alternating current (AC) into direct current (DC) is what a rectifier is all about. A rectifier is a device that converts alternating current (AC) into direct current (DC). Both "half-wave" and "full-wave" rectifiers are used for rectification. Diodes are used in both devices to convert AC current into DC current.

The Half-wave Rectifier

The half-wave rectifier is the simplest type of rectifier since it only uses one diode, as shown in figure.

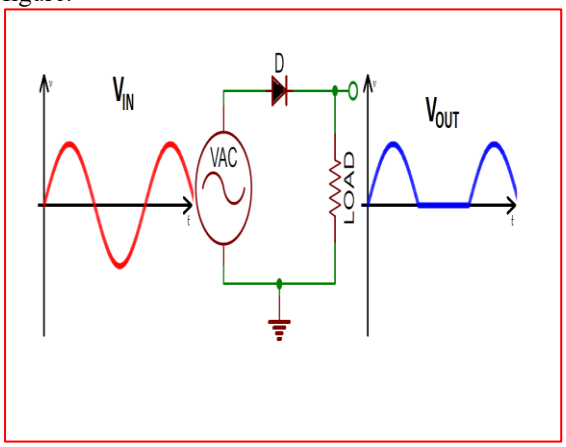


Figure 5 :Half Wave Rectifier

LIQUID CRYSTAL DISPLAY

An array of color or monochrome pixels arranged in front of a light source or reflector makes up a liquid crystal display (LCD), a thin, flat display device. Two polarizing filters, with their polarity axes perpendicular to one other, and a column of liquid crystal molecules hanging between two transparent electrodes make up each pixel.

Light would not be able to travel through them if the liquid crystals weren't interposed. To make light flow through two filters, the liquid crystal changes the polarization of the light entering the first filter.

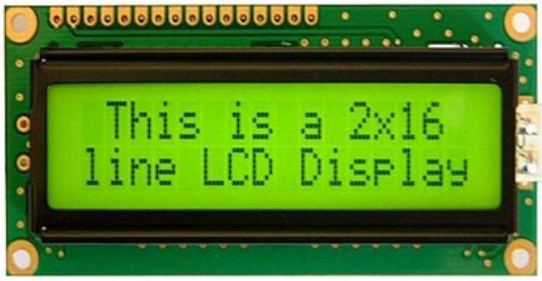


Figure 6: 2x16 LCD Display

ESP8266 Wi-Fi Module

This project revolves on this. Because the project relies on WIFI control of appliances, the module is a crucial part of it. This little board has an amazing MCU (Micro Controller Unit) integrated, which gives the possibility to control I/O digital pins via simple and almost pseudo-code like programming language. The ESP8266 Arduino compatible module is a low-cost Wi-Fi chip with full TCP/IP capability. The Chinese company Es press if Systems is situated in Shanghai and makes this gadget. In August 2014, this chip made its debut in the ESP-01 version module manufactured by the third-party company AIThinker. This small module enables the MCU to establish basic TCP/IP connections and connect to WiFi networks. He was He piqued the interest of many hackers and geeks due to his tiny size, cheap pricing (1.7–3.5$), and potential usage in a wide range of projects. Since it has been so successful, Espressif has released other variants with varying proportions and technological specs. Its replacement includes ESP32. These are the measurements of the board: 14.3 mm x 24.8 mm.



Figure 7: ESP8266 wi-fi Module

DRIVING A RELAY:

Two of the SPDT relay's five pins are used by the magnetic coil, one serves as the common terminal, and the other two are typically closed and normally connected. The coil is activated when a current

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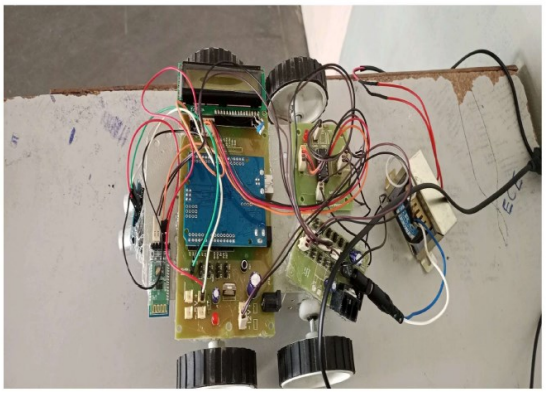
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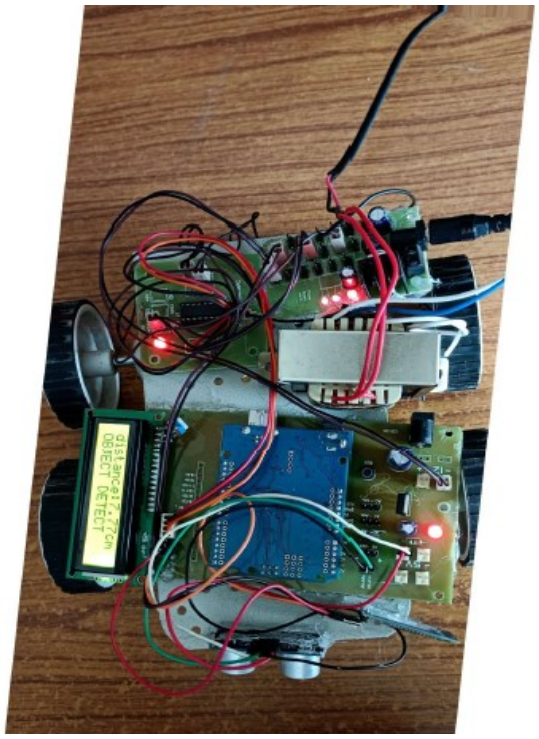
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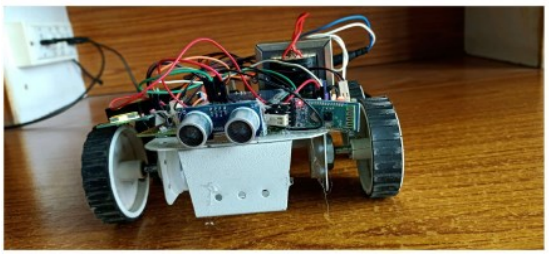
passes across it. At the beginning, when the coil is deenergized, the usually closed pin and common terminal will be connected. A new connection will be formed between the common terminal and usually open pin when the coil is activated, breaking this connection. Therefore, the relay will be activated whenever the microcontroller sends an input signal to it. You may drive the loads connected between the common terminal and typically open pin while the relay is on. Consequently, the high-current loads are driven by the relay, which receives 5V from the microcontroller. This means the relay may be used as a means of isolation.

The microcontroller and digital systems do not have enough current to operate the relay. In contrast to the 10 milliamps required to activate the relay's coil, the microcontroller's pin can only provide 1 or 2 milliamps. This is why the microcontroller and the relay are separated by a driver, like ULN2003, or a power transistor. By connecting ULN2003 to the relay and microcontroller, it is possible to activate many relays simultaneously.

RESULT







CONCLUSION

Taking everything into account, we have improved our pathfinding and obstacle-avoiding algorithms via actual testing on a test model automobile. Based on real-world testing, our system can recognize and navigate with greater accuracy. Because it is a dual-phase algorithm, it may be implemented with little power consumption and still provide a trustworthy ideal route. It has potential uses in the military, in scientific investigations, and in environments where the presence of humans may be harmful.

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