DESIGN AND IMPLEMENTATION OF FPGA BASED RESCUE BOT

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ABSTRACT:

Presently, surveillance in border areas is a very difficult feat. The security staff is enforcing the law at the border in a hostile way. Already implanted video surveillance is helpful, but they would only cover a tiny area. Due to the incapacity to instantly change the camera point of view, the cameras that already are left in place are not very invaluable. Also, it is not permitted to put cameras in tropical areas since trees obstruct the cameras' angle of view. The design and implementation of a wireless robot that can recognize about internet and it can able to detect matter with the help of a Passive Infrared sensor are obscured in the given paper. The entire system consists of an Internet-controlled mobile robot with a mounted camera and a PIR sensor for the detection of living creatures. The user will have wireless control of the robot thanks to the ability to operate it through the internet. The PIR sensor will also provide the user with information about the detection of live beings on the computer, and the user can also view the robot's video transmission at the same time. The arm camera can move vertically along its vertical axis and diagonally around its vertical axis. The user interface on the internet allows the user to control the camera's movement, giving them a better perspective of their surroundings.

KEYWORDS:

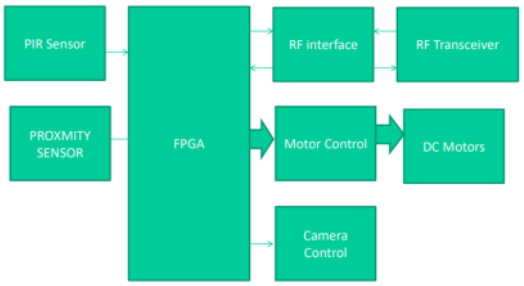
Obstacle blocks; Obstacle avoidance; Opto-coupler; Passive infrared sensor; Radio frequency; Direct current

1. INTRODUCTION:

A realistic opportunity for robotic controls and the development of new control theory methods has been made possible by the advent of newer high technologies and growing computer capacity. Because of this technological advancement and the requirement for high-performance robots, new robot control devices, new drivers, and sophisticated control algorithms were used to develop quicker, more accurate, and more intelligent robots. A robotic arm is essentially a robot that is mounted or placed on a moveable platform and can become with the aid of specific instructions. Many professions employ mobile robots in the modern world. The basic mobile robots are the ancestors of many of the sophisticated robots we see today. His technique has expanded the number of new possibilities in the sector. In several industries, new ideas are emerging as a result of the marriage of mobile technology and robotics. The fact that mobile devices are increasingly widely employed in industrial settings is largely attributable to their portability and greater battery life than laptops. Additionally, we have such a data package through a cell phone provider, which is useful since, once a connection is made, we may communicate with the mobile robot. Robots on wheels: Different types of portable robots can be identified. A tracked robot is a machine that moves about by using a track. However, building such robots is costly. Additionally, they lack the wheeled

robots' flexibility. These robots can only move on level, smooth surfaces. The third category consists of human-like-legged robots. They can move around more easily since they have legs. These robots are exceedingly difficult to construct. Robots are used in a variety of sectors for operations such as pick-and-place, painting, subsystem assembly, and material handling in hazardous settings. As technology progresses in the fields of CPU, sensors, memory, etc., robots become increasingly intelligent. Even in defence, there are always difficult applications. With the Internet's explosive expansion, an increasing number of intelligent systems devices which had been integrated it for purposes of entertainment, securities and service, including distributed computer systems, security cameras, telescopes, manipulators, and mobile robots. Although the concept of World wide web robots / web-based robotics is still in its infancy and is relatively new, it has piqued the intense attention of several scholars throughout the globe. Internet robotics has created a completely new set of real-world applications, such as TV, Radio, Remote patient, National gallery mentor, Traffic monitoring, Space research, Tragedy liberation, House cleaning, and Health care, aside from operating in hazardous environments, which are traditional Tele-robotics areas. The business sector also prioritizes research in automated video monitoring. Technology has advanced to the point that placing cameras to record video is inexpensive but finding people to watch the footage is costly. Commercial buildings already have a high prevalence of surveillance cameras, and the output of these cameras is recorded on cassettes that are either frequently overwritten or kept in video archives. Whenever an individual arrives at a monitored location, Pir sensor detectors are frequently employed in combination with various areas of the battlefield in this robotic system deployment. When someone enters a secured area, wireless communication quickly sends an alert to the control room section, and the control room is notified via the alarm. A worried individuals might comprehend that a situation has occurred in the host part. While this is happening, a web camera that is attached to the Micro controller continues to record what is happening at the host location and saves it to the computer. When an alert signals the host section, the security personnel in the supervisory room connect to the host section computer over the internet and access all the warfare field section footage.

2. BLOCK DIAGRAM :



Block diagram of the rescue robot

2.1 PASSIVE INFRARED SENSOR:

A PIR is an electrical device. It monitors the infrared light emitted by objects within its field of vision. PIR-based motion detectors frequently make use of PIR sensors in their design. Using a concept similarly linked motion detector, migration of people, wildlife, or other things can be detected. They are frequently utilized in lighting control systems and burglar alarms. Whenever a temperature gradient with one temperature, like a person, moves in front of an IR transmitter with another temperature, like a wall, apparent motion is detected. The most common type of radiation that could be detected by electrical equipment made for this purpose, but is nearly invisible is infrared radiation. In this context, the word "passive" refers to the PIR device's passive reception of incoming infrared radiation rather than its active emission of an infrared beam. Every item with a temperature greater than absolute zero radiates thermal energy (heat). The Transmitters are calibrated to recognize this IR wavelength, which only emerges when a person enters their range. The heat that produces electricity is what the word "pyroelectricity" is. Such sensors are also referred to as passive since they lack an internal infrared source.

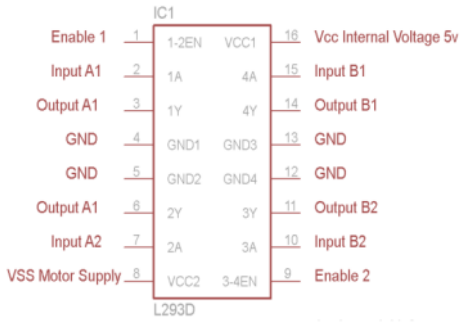
OPERATION:

Based on the temperatures and surface properties of the object in front of the sensor, each PIR sensor detects variations in the quantity of infrared impinging upon it. The sensor turns the ensuing output voltage fluctuation into infrared light to activate the detection. The detector may occasionally be triggered by moving objects that are comparable in temperatures to the background but have varied surface properties due to their differing infrared emission patterns.

PIRs are available in several configurations for several purposes. The most popular types include several Lens or mirror segments, a field of view smaller than 180 degrees, and an effective range of roughly ten meters (thirty feet). There are models with 360-degree or even broader fields of vision that are often made to install on ceilings.

2.2 Motor driver:

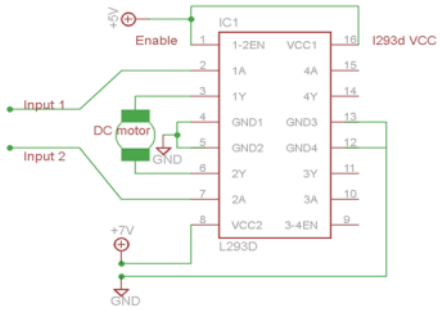
The L293D is the driver of a simple motor integrated circuit (IC) that allows DC motors to drive in either direction. The 16-pin IC L293D can drive two DC motors simultaneously in either direction. That is, a single L298n motor IC may control two DC motors. Included is a Duo H-bridge Motor Driver (IC). It operates according to the H-bridge theory. Voltage may go in either direction thanks to a circuit design known as an H-bridge. Given that a DC motor has to be able to rotate either clockwise or anticlockwise, as you are aware, the H-bridge IC is ideal for this application. Below is a pin schematic for an L293D motor controller. On the switches, there are two enable pins. Pins 1 and 9 need to be linked to a high-voltage source in order to run the motor. To use the left H-bridge to drive the motor, Pin 1 must be elevated. On the right H-Bridge, pin 9 must also be raised. It functions similarly to a switch.



Working of L293D:

The L293d has four input pins, which are represented on the pin's diagram as pins 2, 7, 15, and 10. Left input pins will control the rotation of the motor linked across the left side, and right input pins will control the rotation of the motor connected across the right side. The motor is rotated based on the Logic 0 or 1 inputs delivered via the input pins.

Circuit Diagram for L293D Motor driver IC controller:



The maximum current per line is 600mA. With this l293d, you can drive a rather large motor because it can run motors approximately to 36 volts. The voltage on Vc pin 16 is designed for its own operating units. The maximum voltage varies from 5 to 36 volts.

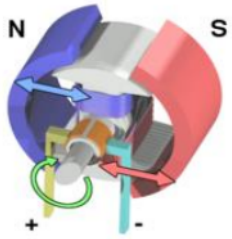
2.3 METAL DETECTOR:

An electrical gadget called a detector analyzes the presence of metal around. Metals inclusions that are concealed within objects or metal objects which are buried underground can be found with metal detectors. A portable device with the a sensor probe that can be moved over the floor or any other surfaces is a common component of these devices. The earphones' tone changes, the needle on an indicator moves, or a sensor moves when it detects a metal item. Typically, the gadget indicates proximity; the nearer the metal is, the louder the sound in the ear or even the stronger the needle moves. Permanent "walk-through" metal detectors are another common type used at airports, courts, jails, and security checkpoints to look for explosives. When an electrical conductor metal is put near the coils, eddy currents form in the metal, forming the formation of its magnetic field.

2.4 DC MOTOR:

A revolving electrical device known as a DC motor converts electrical energy from direct current into mechanical energy. The ones that depend on magnetic force are the most common. A almost universal inner mechanism, either electromechanical or electronic, is used in DC motors of all types to some time alter the direction of current flow in a particular area of the motor. Since direct-current lighting power distribution networks were already in place, DC motors were the first electrical devices to be widely used. Elevators and hoists, steel rolling mill drives, and electric vehicle propulsion all make use of larger DC motors. Power electronics innovations have made it possible for AC motors to replace DC motors in many applications.

DC motor



2.5 CAMERA:

An optical device known as a camera is used to record or capture pictures that can either be locally stored, sent to another place, or both. The images may be single still photos or collections of images that make up films or movies. Since it perceives objects without coming into touch with them, the camera is a distant sensing device. The Latin term for the first apparatus for projecting a picture of the outside world onto a flat surface, camera obscura, which translates to "dark chamber," is where the word camera originates. The camera obscura gave rise to the contemporary photographic camera. The operation of the camera is quite like that of the human eye. The visible spectrum of light and other regions of the electromagnetic spectrum may both be used by cameras. An optical tool known as a still camera captures a single image of an item or scene and stores it on a photographic film or electronic sensor. Every camera has the same fundamental construction: a converging lens or convex lens lets light into the enclosed space, and a picture is then captured on a light-sensitive material (mainly a transition metal-halide). A shutter mechanism controls how much light enters the camera. The illusion of motion is achieved by merging and arranging the images in the correct order.

2.6 PIC16F877A:

INTRODUCTION:

The PIC16F device family uses CMOS technology (Complementary Metal Oxide Semiconductor). The advantages of CMOS technology over competing technologies are numerous. For instance, CMOS circuits are highly tolerant of poor designs and electrical noise, require very little power

and work across a wide voltage range. PIC, or "Peripheral Interface Controller," was the original meaning of the word.

MEMORY

There are three separate memory portions in the PIC16F877A:

FLASH MEMORY

The software that a user installs onto the Microcontroller is stored in flash memoryThe software is retained even when the power is turned off because to flash memory's non-volatile nature. Flash memory measures 8K by 14 words flashing on the PIC16F877A.

EEPROM

Data like variable values are stored in this additional non-volatile memory type. A PIC16F877A has a 256-byte EEPROM.

SRAM

SRAM is the volatile memory of the Microcontroller. which means it loses data when the power is turned off. The PIC16F877A has 368 Bytes of inbuilt SRAM.

OSCILLATOR

Flexible clock choices are available with the PIC16F family. This series is capable of receiving external clocks up to 20 MHz. Additionally, these controllers have an inbuilt oscillator with eight adjustable frequency settings ranging from 31 kHz to 4MHz.

ADC INTERFACE

The PIC16F877A comes with eight 10-bit ADC (Analog to Digital Converter) channels. Analog inputs, eg., sensor inputs, are converted by ADC into digital values that the Microcontroller can process.

TIMERS/COUNTERS

The PIC16F877A contains three timer/counters. The remaining timers have the option to pick 8 bit mode, and there is one 16-bit timer. Timers are helpful for producing exact activities, including producing accurate time delays between two tasks.

INTERRUPTS

PIC16F877A has just one external interrupt source. Different peripherals including USART, ADC, Timers, and others are connected to 14 internal interrupts.

CSP and ICD

For programming the Flash Memory without removing the IC from the circuit, PIC16F series controllers include an In-system programming (ISP) capability. When the controller is placed in an application circuit, the ICD, which allows hardware debugging, is engaged.

SPI

Asynchronous transmission and reception of 8 bits of data are possible when utilising the SPI mode. The whole range of SPI modes is supported. In order to connect two devices that use the same clock source, the PIC16F offers 4-wire SPI communication. Compared to USART, SPI has a faster data rate.

I2C

I2C communication between two devices is supported by PIC16F's Two-Wire Interfaces (TWI). It has the ability to function as a Master and a Slave device. The MSSP module in I2C mode completely implements both master and slave operations as well as providing hardware interrupts on the START and STOP bits to find a free bus. The standard mode standards, as well as 7-bit and 10-bit addressing, are implemented by the MSSP module.

USB

Full-speed USB is supported by PIC18F with a variety of clock configurations.

PSP

The Parallel Slave Port interfaces the PIC Microcontroller with a microprocessor system directly. It has an 8-bit read/write data bus as well as WR (write), CS (chip select), and RD (read) inputs that are all active low.

PWM

With PWM, you get a single 10-bit Pulse Width Modulation output that runs entirely on its own once it's begun, unless you decide to adjust the duty cycle. PWM also has no software overhead.

The frequency of the PWM is defined by the Timer 2 period register, which is used to determine the timer's function.

DATA MEMORY ORGANIZATION

GPR and SFR are stored in several blocks that make up some data in memory through the PIC16F877 (SPR). These blocks may had different depending on the kind of Micro controller. With only four banks from 0 to 4. In each block , there is a accessible memory which consists of 128 bytes.

The Special Function Registers (SFR) and General-Purpose Registers (GPR) sections of data memory make up the entire device. SFRs manage the device's operation, whereas GPRS is the broad region for data storage and scratch pad operations.

Both the GPR and SFR regions have data memory banked. Amounts of general-purpose RAM larger than 96 bytes can be addressed thanks to the banked GPR region. The registers that manage the core and auxiliary functions are those for which SFRs are used. Banking necessitates the usage of control bits to pick a bank.

The STATUS Register (STATUS<7:5>) has these control bits. Values must first pass through the W register before being transferred from one register to another. This indicates that two instruction cycles are required for every register-to-register transfer. Direct or indirect access to the complete data memory is possible. The usage of the RP1:RP0 bits may be necessary for direct addressing. The File Select Register is required for indirect addressing (FSR).

Indirect addressing makes advantage of the STATUS register's Indirect Register Pointer (IRP) bit to reach data memory regions Bank0 / Bank1 or Bank2 / Bank3.

GENERAL PURPOSE REGISTERS (GPR)

Banked memory is present in the GPR region of several Mid-Range MCU devices. GPRS stays unchanged on all other resets and is not enabled by a Power-on Reset. Depending on the current data memory bank, a read or write to some devices' common sections across the data memory banks will result in the same location (value).

SPECIAL FUNCTION REGISTERS (SFR)

The CPU and peripheral modules employ the SFRs to regulate the device's desired functioning. As static RAM, these registers are implemented.

There are two types of SFRs: those linked to the "core" function and those linked to the peripheral functions. The SFR section of the banked memory is present in every Mid-Range MCU device. The STATUS register's RP0 and RP1 bits must be set for the target bank in order to move between these banks. Power-on Resets and other resets may activate some SFRs while leaving others dormant. The FSR can be utilised directly or indirectly read the register file.

PROGRAMMING

The ability to reprogram PIC Microcontrollers, which employ flash memory, is one of their most helpful characteristics. Each PIC Microcontroller features an ICSP serial interface that may be used to program the device while it is still linked to a circuit. Assembly or a higher-level programming, may include C Programming, which was far more user-friendly, may both be used to program a Micro controller. You are not needed to use the exact processor after you have able to learned about many higher-level programming.

SPECIAL FEATURES

WDT

This timer restarts the CPU if your program malfunctions. Periodically, well-used software can use the CLR Watch Dog Timer command which can halt it to stop. With the help of its oscillator, the WDT functions. The shared Timer 0 Pre-scaler is used when it is sleeping.

POR

When a rising edge on MCLR is detected, Power on Reset initiates PIC Microcontroller start-up.

PWRT

The PIC Microcontroller will start 72 milliseconds after a POR if you activate this.

OST

The primary coil of a power system can also be moved upward or downward depending on the required Random value, when Alternative Current is used. In our circuit, a 230Volt/15Volt transformer is used to change 230Volt AC into 15Volt AC across the secondary coil in order to complete the step-down process.

SLEEP

This command is used to enter sleep mode (or low power usage mode). The device can be induced to wake up from sleep because of an external reset, Watch Dog Delay timeout, INT pins RB terminal change, or periphery event.

3. CIRCUIT DIAGRAM DESCRIPTION:

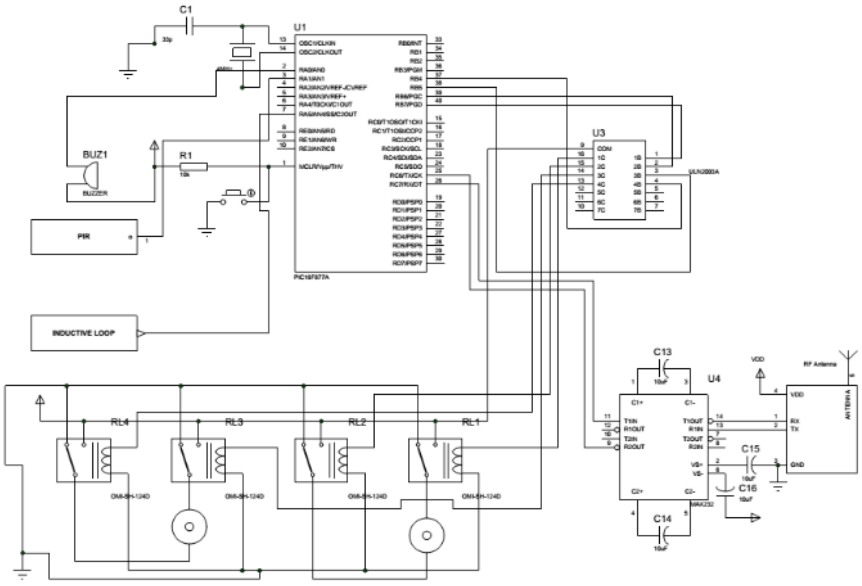
The essential coil of a power system can also be moved upward or downward depending on the needed DC value, when Alternative Current is provided. In our circuit, a 230Volt/15Volt transformer is applied to change 230Volt AC into 15Volt AC across the secondary winding in order to finish the step-down operation. A solid-state diode is widely used in the power supply unit to rectify. When properly biased, the diode has the feature of allowing easy one-way electron passage. The anode and cathode must be negative for electrons to pass through the diode as AC is applied. By inverting the polarity of the voltage, electron flow is blocked.

33 I/O pins make up the PIC16F877A's 40-pin DIP pack. Both digital I/O and analog input are possible on nine of the pins. Ports A, B, C, D, and E are the blocks of Microcontroller. Either digital or analog pins can be used for Port A's six pins. Port E includes three pins that may be utilized as A/D pins. The Liquid Crystal Display pins are coupled to D Port. Data pins RD 0 to 3 are the data based pins, whereas control pins RD 5 to 7 are the control based pins. Oscillators are attached to Pins 13 and 14. This oscillator is used by the PIC Microcontroller to provide the necessary clock reference. The power supply pins might be either pins 11 and 12 or pins 31 and 32. The Micro controller's 11th and 32nd pins get 5v power, whereas the 12th and 31st pins receive GND. When communicating via a serial port, Port C's pins 25 and 26 are used. MAX232 is connected to these pins for communications over a PC. Hex code is downloaded to the Chip via in-circuit debugger operations, which are performed on pins 39 and 40. An external interrupt pin is utilized on Pin 33. The reset pin is Pin 1, thus. This Pin connects to Vcc via a resistor.

Our LCD for this project was an HD1234 display. This alphanumeric LCD has 16 pins. Pins 7–14 serve as data pins, whereas Pins 11–14 connect to the PIC16F877A Microcontroller's port D. The three control pins are RS, RW, and EN. The 29th pin of the Microcontroller is coupled to Register Selector pin. Normally, the Read/Write pin is landed down. Pin 28 was coupled to RW. Also, the 30th pin is coupled to the Enable (EN) block. There are 2 rows and 16 columns on the LCD display. Pins 1 (GND) and 2 are linked to a 5V supply to turn on the LCD (Vcc). With the use of a potentiometer, Pin 3 is linked to Vcc. Adjusting the contrast level is done with a

potentiometer. We utilize the PIC controller in the 4-bit mode for this project. In this instance, the Data Port is only connected to and using 4 data pins. The 27th Pin of the Microcontroller is linked to the RS pin. In most cases, the RW pin is grounded. On the 26th Pin, the RW is plugged in. A 28th pin is used to link the EN pin. Two rows and sixteen columns make up the LCD.

The ADC port of the PIC16F877A Microcontroller is interfaced with a PIR sensor and metal detectors. In a linear relationship with the measured values, the LM35's output voltage is produced. The output voltages from the LM35 are transformed into digital signals by the inbuilt ADC. The PIC16F877A Micro controller's second pin is wired to the third pin (output) of the PIR sensor and the second pin of the metal detector.



4.CONCLUSION:

Our security officers are assisted in their efforts to detect intruders by using the suggested technology. As parts of our border regions fall into high-altitude regions, this robotic technology may also be deployed there, where it is impossible for people to live. The suggested robotic system can also be utilised to locate wounded people during natural catastrophes such as earthquakes and building collapses, as well as in mining operations and as a spy robot. A PIC Micro controller and an embedded platform were used to create the surveillance robot. A surveillance robot can continuously watch and protect a location from intruders with high accuracy and precision Use of an IP camera allows for continuous monitoring of the area and transmission of information to the

control centre. Contrary to the traditional way, the robot's movement is more precisely controlled by the Servo motor that is being employed. This robot may also be utilised in times of environmental catastrophes when the robot recognises whether a human is present in that region and is alive. The future scope of the project has several opportunities that might be continued for many future applications in monitoring and controlling, etc. Using this technology, domestic applications like home security may likewise be built.

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