Automatic Gate Lock with Visitor Counter

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Abstract **- This is an IoT-enabled RFID based door locking gadget. This door lock system will know how long the door is open and in this door lock system, only those people who register will be able to enter using their card. It uses a servo motor that operates with the help of Arduino. The Arduino board runs with complete programming that is stored inside it. By using this gadget, an owner can track his office and the place where he wants to let the specific people in. It is also very secure. RFID Module, LCD Display Red and Green and Yellow LED Light and Buzzer have also been used in this door lock system. When the door is locked, the yellow LED will be on and when the door lock is open, the green led light will turn on. The Red LED work will alert you that your card is wrong.**

Micro controller or Microprocessor is the most flexible device in the world. It is once a creature of science fiction is today a reality. In real sense, it is a device, which allows human beings to build new machines with their intelligence .Visitor counting is used to measure the traffic at certain places while entering and exiting offices, malls, sports venues, etc. Counting the visitors is a tough job to do by a individual which accumulates a lot of crowd because it takes time for a individual to count on the crowd. it is not limited to the entry/exit point of a place like company malls etc but it also provides the information of the flow of volume of people from one place to the other. before they were hiring individuals to keep an eye on the count but as it is a time taking process and possibilities of making error is high .so, its better for machinery to do the job. As, human collected data comes out with a lot of expense now a days.

INTRODUCTION

This gadget is designed with the help of an Arduino using a servo motor that pushes the gear forward and back. When we scan our register card, there is a loop start of store programming in which the servo motor rotates 90 degrees, then the gear mechanism in it works, which locks and opens the lock. We have designed a project to get the count of the people when they enter they enter the hall and when they exit the hall. we can maintain the flow of crowd. so first after connecting the components which will be mentioned below in the paper. we are using a 8051 micro controller which is used to give commands to the components to complete the process. So to insert code into a micro controller we typed the code in the keil software the converted the keil file to hex file by following certain steps. After getting the hex file we can insert it into the micro controller so that it can perform the functions. After setting up the code then when the person enters the walk way we will be having two pairs of IR transmitter - receiver pair which help to get the count of the person when there is an interruption of rays between the transmitter and receiver . so through the ports if there is an interruption we will get the count on the LCD screen of the people entering and exiting the hall or a room.

METHODOLOGY

The Arduino Uno R3 Compatible board is an electronic hardware device used to build and program electronic circuits and projects. The board is based on the ATmega328P microcontroller and is designed to be compatible with the Arduino Uno R3 board, which means that it can be programmed using the Arduino software and libraries.

The board features 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, and an ICSP header. The digital pins can be used as input or output pins and can be easily controlled using the Arduino programming language. The analog inputs allow the board to read analog signals, such as those from sensors, and convert them into digital signals for processing.

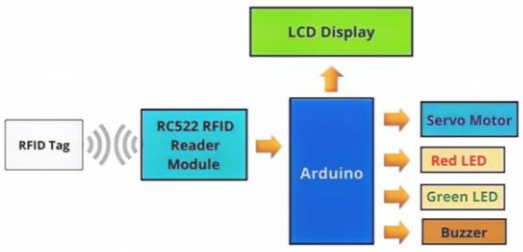

Fig.1. Block Diagram of Gatelock System

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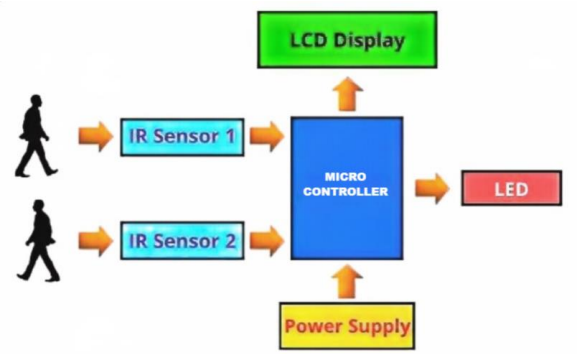

Fig.2. Block Diagram of Visitor Counter

HARDWARES

1. ARDUINO UNO R3

Fig. 3. Arduino UNO R3

The board also features a power regulator that can accept a range of input voltages, from 7 to 20 volts, and regulate it to a 5-volt output that is used to power the microcontroller and other components on the board. Additionally, the board includes a reset button, which can be used to restart the program running on the board, as well as an LED indicator that can be used for debugging and status monitoring.

The Arduino Uno R3 Compatible board is an excellent choice for hobbyists, students, and professionals who are looking for a low-cost, easy-to-use, and flexible platform for building and prototyping electronic projects. The board is compatible with a wide range of sensors, actuators, and other components, making it ideal for a wide range of applications, including robotics, automation, data logging, and more. Its open-source nature and large community of developers and enthusiasts make it an excellent platform for learning, experimentation, and innovation.

2. RFID TAG

Fig.4. RFID Tag

This is RFID Reader/Writer RC522 SPI S50 CARD AND KEYCHAIN which works on non-contact 13.56mhz communication, is designed by NXP as low power consumption, low cost, and compact size read and write chip, is the best choice in the development of smart meters and portable hand-held devices.

It uses an advanced modulation system, fully integrated at 13.56MHz with all kinds of positive non-contact communication protocols. Support 14443A compatible answer signal. DSP deals with ISO14443A frames and error correction.

This module can fit directly in handheld devices for mass production. The module uses the 3.3V power supply and can communicate directly with any CPU board by connecting through the SPI protocol, which ensures reliable work, good reading distance.

3. 16X2 LCD DISPLAY

Fig.5. 16X2 LCD Display

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc.

These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

4. SERVO MOTOR

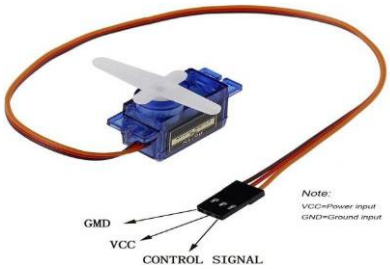

Fig.6. Servo Motor

As our technology advances, the use of robots and other autonomous applications in our daily lives increases as well. While cheaper robots use stepper or brushed DC motors, more advanced robotics require the use of servo motors.

A servo motor is a self-contained electrical device that moves parts of a machine with high efficiency and great precision. In simpler terms, a servo motor is a BLDC motor with a sensor for positional feedback. This allows the output shaft to be moved to a particular angle, position, and velocity that a regular motor cannot do. However, a servo motor is only one part of a closed-loop motion control system. A complete motion system includes an amplifier, control circuit, drive gears, potentiometer, shaft, and either an encoder or resolver as well as the servo motor.

5. BUZZER

Fig.7. Buzzer

An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

The pin configuration of the buzzer is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '-'symbol or short terminal and it is connected to the GND terminal.

6. IR SENSOR

Fig.8. IR Sensor

IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations.

The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode . Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific wavelength used as infrared sources.

The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibers. Optical components are used to focus the infrared radiation or to limit the spectral response.

RESULLT AND DISCUSSION

This Arduino RFID door lock project combines RFID card authentication, servo motor control, and

ultrasonic sensing to create a secure and interactive door lock system. The integration of these components provides both access control and the ability to detect potential visitors at the door. You can customize the project by adding more features, such as logging access attempts or integrating it with a home automation system.

Firstly, identify these components.Secondly, connect the servo motor and the lock as shown below. Use the iron stick for that.Thirdly, glue this lock and servo motor to the foam board.Now, connect all the components to the Arduino board. Now let's create the program for scanning RFID tags.Firstly, I2C, SPI, and RFID libraries are included.

Secondly, the RST and SDA pins are defined. Also, two variables have been created to help the program.Thirdly, objects are created for I2C and RFID libraries.In the setup function, the Serial monitor, LCD, SPI bus, and RFID module are started. Also, "Put your card" is printed on the LCD.In the loop function, the RFID tag is scanned and the UID is printed on the serial monitor and LCD.Now, select board and port. Afterward, upload this code to the Arduino board.Then, turn on the serial monitor and bring the RFID tag closer to the RFID reader. Now, get the UID and copy it.

Next, create the main program for this project.Firstly, servo, SPI, I2C, and RFID libraries are included.Secondly, the RST and SDA pins are defined. Also, a string variable is created for placing the UID.Thirdly, three objects have been created for Servo, I2C, and RFID.In the setup function, the Serial monitor, LCD, SPI bus, servo, and RFID module are started. Also, the servo motor rotates 70 degrees.In the loop function, the first thing printed on the LCD is "scan your card".Also, the second code part reads the RFID tag. At that point, appears as "scanning" on the LCD.

Next, the third part of this code tests this UID using the IF condition. Also, the servo motor rotates 70 degrees and 160 degrees. Then, the lock moves forward and backward. On the LCD appears as "Access controlled" and "Acess denied". If the RFID tag is incorrect, it will be printed as "Wrong Card" on the LCD display.Now, enter your UID in this code.

The circuit works on the principle of IR sensing. Infrared or simply IR Sensors are devices that work with Infrared Light Source and a Photo Detector like a Photo Diode or a Photo Transistor that act as a Transmitter and Receiver respectively.

In this project, we have used an IR LED as the IR Transmitter and a Photo Diode as the IR Receiver. Two sets of IR sensors consisting of an IR LED and Photo Diode are placed at two ends of the entrance of a room.

Output from each sensor is fed to the microcontroller. In normal operation, IR light from the LED would not fall on the Photo Diode as it is a Reflective type IR Sensor. The output from the sensor would be a logic LOW signal in this case.

In case of any interruption (due to any person crossing the path), the Photo Diode would start receiving the IR Light and start conducting. As a result, the output from the sensor would be a logic HIGH signal.

The transition from low to high, for each sensor pair is detected by the microcontroller and accordingly the count would be increased or decreased.

The heart of the circuit design lies in designing the Microcontroller interface. Here,we used the Microcontroller AT89C51, which is an 8051 family microcontroller.

The microcontroller AT89C51 is interfaced to the IR sensor pairs at PORT2 pins – P2.0 and P2.1 respectively. The following image shows the circuit diagram of the Reflective Type IR Sensor Module used in this project. The sensor circuit is designed by selecting appropriate value of resistors for both the LED and the Photo Diode. A 150Ω current limiting resistor is placed in series with the IR LED.

Photo Diode is connected in reverse bias with a series resistor of 10KΩ. Photo Diode and 10KΩ Resistor form a potential divider and the output is given to the non – inverting input of the Operational Amplifier (Op – Amp).

A 10KΩ POT is connected at the inverting input. This POT can be adjust in order to change the sensitivity of the IR Sensor. A 16 x 2 LCD Display is used to display the count values. The data line of the LCD are connected to PORT1 Pins of the Microcontroller.

The Control Pins i.e. RS, RW and E are tied to P3.6, GND and P3.7 pins. A 10KΩ POT is connected to contrast adjust pin i.e. Pin 3 of LCD.

Another important aspect of the design involves designing the oscillator circuit and the reset circuit. The oscillator circuit is designed by selecting an 11.0592 MHz quartz crystal and two ceramic capacitors – each 33pF.

The reset circuit is designed by selecting a resistor of 10KΩ and an electrolyte capacitor of 10µF to ensure a reset pulse width of 100ms and reset pin voltage drop of 1.2V.

CONCLUSION

In our exploration of modern security solutions, we successfully designed and implemented an RFID Based Door Lock Security System using the RC5222 Module and Arduino. The fusion of RFID technology, known for its efficiency and resistance to duplication, with the adaptability of the Arduino microcontroller, has paved the way for a reliable and advanced security measure. Our system efficiently evaluates the information from an RFID tag when placed near the reader, granting or denying access based on the stored data.

This project not only showcased the potential of RFID technology but also highlighted the seamless integration capabilities of the Arduino with the RC5222 module. Such innovations underscore the potential of combining traditional security measures with modern technology, offering a glimpse into the future of security systems.

This project titled “Bidirectional Visitor Counter” helps us to measure the people entering and exiting from the path or ways. This project helps us to find the number of people present in the hall which will be displayed on the screen as we attached a LCD display. This is not only limited to the counting of entering and exiting people it also helps us to manage the flow of people throughout the location.

The circuit may also be enhanced with a wide counting range of above three digits by modifying software section of the system. It can also be enhanced for long and accurate sensing range using a laser torch instead of IR transmission circuit. Thus the circuit can be used to monitor visitor flow in effective manner, where the visitors have to counted and controlled.

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