



Optimized Locking and Unlocking a System Using Arduino

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ABSTRACT: Smart Home Automation System playing a major role which helps in reducing a work by using some technologies. The proposed work is to send a signal to door from a Tablet or mobile devices by using wireless system. This allows the user to lock and unlock a door from inside or outside a house with a Wi-Fi range available. The ideal purpose of the work is, if the door is not locked in First floor or in any other floor, the user from ground floor they can open the door or unlock the door from mobile phone or Laptop, which makes a person to reduce its energy or save time. The major components of the system are Latest Arduino Board, Servo Motor and Wi-Fi (IEEE 802.11b/g/n) standard protocol for wireless communication which combines and forms an activity. The open source Software and Hardware with embedded device is used to give a complete task.

KEYWORDS: Arduino Yun Board, Servo Motor, Wi-Fi.

I. INTRODUCTION

Embedded System

After 1960's there is sudden enhancement in the embedded system [1] for various applications in a real time all over the world. Embedded system is a part of an Electrical, mechanical and computer software device. This system is designed to work in various environments for efficient output. Mostly Embedded systems are not standalone devices, works on some operating systems like Linux, Windows and Mac OS, and it is designed for high performance, security, usability, storage and Maintenance. There are many embedded devices like Mobile, Computer, Electronic Gadgets, Washing Machine, Airplanes and So on. Most of the embedded systems hold Microprocessor and Microcontroller inside it. This project was designed to open a door anywhere from home or building using Wi-Fi. This makes a user to open a door either from Laptop or in a Mobile Phone with android application. The idea behind this project is to close or open the door anywhere in our home or Organisation from a single location via Wi-Fi, because now-a-days Wi-Fi is available in many areas for transferring a signal. This is performed in a home when a handicapped person or children would be alone in home. Here Arduino Yun Board, Wi-Fi and Android Application playing a major role.

Wi-Fi

Wi-Fi [2] is a Local Area Wireless Technology that allows electronic components to exchange the data using radio waves. This technology is increased with more security by adding some high quality protocols like WPA and WPA2. The Wi-Fi enabled devices can connect to the internet for accessing a data and transferring the information. It works at the range of 2.4 GHz, 3.6 and further to 5 GHz. The distance coverage is maximum 90 to 100 meters and depends upon the Wi-Fi router the communicating devices extended more. It holds the bit rate of 600 Mbps. In Proposed work, the Wi-Fi which is inbuilt in Arduino Yun Board allows the authorized user to interact with it. By using this wireless communication the signal is transferred in dynamic environment from the mobile or tablet device to receiver side for locking or unlocking a door.

Arduino Yun Board

Arduino [3] is an open source simple tool that can sense, monitor, store, controls more of the applications than the desktop computers. This Arduino Board is designed to interact with various environments, taking input and output from sensors, controlling the switches, devices using software or with human interaction.

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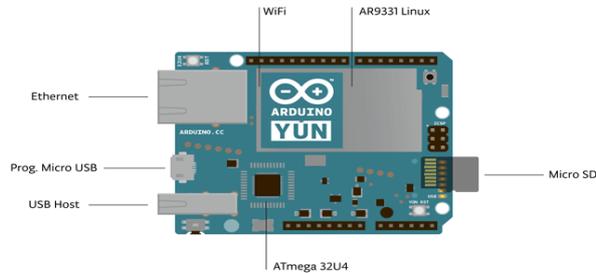


Fig.1. Arduino Yun Board

The view of Arduino Yun Board is shown in Fig.1. Which contains many products like Boards, Shields and kits; each performs various functions based on the situation. In our work, the Arduino Board Called Arduino Yun Board which is 32 grams in weight, with length and width has (73mm X 53mm) is used, it was introduced only on Sep'2013. The major advantage of this Board is it holds an inbuilt Wi-Fi (IEEE 802.11b/g/n) support, USB port, Micro SD card slot, 3 reset button, an In-Circuit Serial Programming header, 16 MHz crystal Oscillator, contains 20 Digital Input/ Output Pins and 12 Analog Channels. The power to the Arduino Yun Board is supplied through USB port with 5V and it holds Ground Pin.

Arduino Yun Microcontroller

The microcontroller is a mini computer built for specific tasks which contains memory, storage, input and output programs on a single Integrated Circuit. In Arduino Yun Board, ATmega32u4 is embedded for performing the operations mentioned above. The Pin out of ATmega32u4 is shown in Fig.2. This microcontroller is low power and high performance AVR 8 bit microcontroller with advanced RISC architecture. This microcontroller holds a flash memory with 32K bytes of In-System Self Programmable, 2.5K bytes of Internal SRAM, 1K bytes of Internal EEPROM. It supports the data transfer rates of up to 12 Mbit/s and 1.5Mbits/s, 12C and SPI communication. It represents the USB specification with 2.0. This microcontroller holds some features like Idle, Power-save, Power-down, standby, extended standby and ADC Noise Reduction. The maximum frequency produced for 2.7V is 8MHz, and the maximum general purpose working registers are 32 X 8.

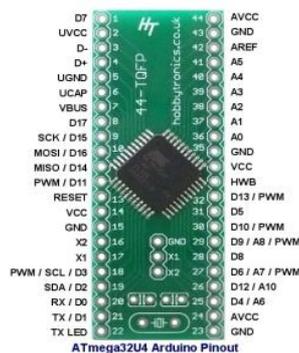


Fig.2. ATmega32u4 Microcontroller Pin out

Servo Motor

The servomotor [4] is a rotary actuator that uses position feedback to control angular position, speed and target position. The servomotors works in a closed loop environment with high performance rather than stepper and induction motor. In our work, we used HS-311 Servo Motor shown in Fig.3 for connecting to Arduino Yun board. This servo holds all the performance and reliability functions which we would expect in high expensive servo motors. It Size is 40mm X 20mm X 37mm with speed of 0.19 in per second and standing weight is 43 g. The combined resin gears and SMT circuitry motor is connected using three pins to the Arduino board.

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Fig.3. Servo Motor

II. RELATED WORK

There are some factors must be considered when designing a smart home system. These factors to be used in various applications. Now-a-days smart home system playing a major task with high and low price, less and more security, less and more efficient. This system enters into a smart home technology by using some controlling mechanisms like Bluetooth, Short message Service, Internet, and using some microchips. In [5] the author used android mobile device that allows the security system to be interface with it. The Bluetooth is used to make a communication between the mobile device and security system. The commands for locking door from mobile phone are sent properly to the door. This communication occurs only for short range (below 10 m). If the devices are operated from more than a mentioned point distance, it never allows the door to be open or close. In [6], the author represented that the door locking and unlocking mechanisms can occur using wireless remote controller. This communication occurs only if the person is near to door because the infrared signal transfers from the remote and reaches to the door receiver only to a shorter ranger. This work also never allows the user to operate the door from longer distance. In this paper [7], author used an android mobile phone for locking and unlocking a door instead of a PC. Here Arduino Uno board is used in the receiver side, which receives the signal from the user and performs the task. This communication also occurs only for a short ranger and the locking and unlocking task can be performed by an unauthorized person also because of lack in security. The Arduino Uno board Supports the HC-05 Bluetooth module and never allows for large range.

In [8] smart home design applications that allows owner to manage their home through internet. Its need a PC to transfer the information to the internet, so a PC is used as a server that increases the price and power consumption while others need web page hosting that need extra cost also. Here said that the use of PC can require considerable cost and can be reduced by using a microcontroller. In [9], the author designed and developed low cost and flexible home automation system. The Arduino BT Board is used for communication and there is a transfer of information between the mobile phone and board via wireless. In this board no module for Wi-Fi and it is to be embedded separately. Here some security mechanisms were used to protect the devices. Even though security is achieved it never allows the devices from longer distance even inside from home. In [10], author used Zigbee technology for monitoring, controlling the devices in home and also for locking and unlocking a door along With MCU sensors. The mobile phone supports portability without compromising reliability is used. Zigbee is a widely deployed standard for providing communication between sensors in low data rate of 250 kbps wireless networks. They low power digital radios with less energy efficient and it faces an access delay communications simultaneously and transmission distance increased only few distance by overcoming Bluetooth.

III. PROPOSED WORK

The proposed work contains three sections like Block Diagram, System Design and Flow Chart. The combination of all section which is shown in Fig.4 used to provide an efficient output. The mobile or Laptop with android apps and Wireless LAN is allowed to transfer a signal over 802.11b/g/n protocol towards an Arduino Yun Board. The wireless LAN module fixed on the board receives the transmitted signal and transmits to the microcontroller. The microcontroller passes the data to the servo motor in order to perform the operations on the Door. The working principles and design of a full system is shown in our proposed work. This proposed work system of design consists of three major components. They are Arduino Yun Board, Servo Motor and Android Apps.

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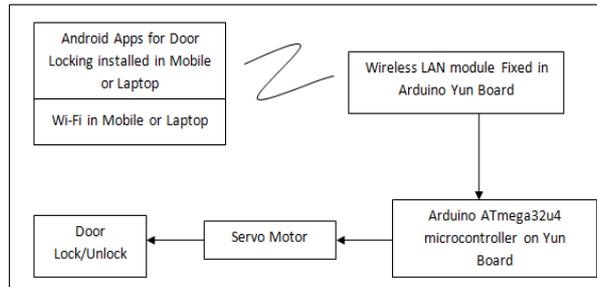


Fig.4. Block Diagram of Overall System View

System Design

1. Arduino Yun Board

Initially Arduino Yun Board of size (73mm length X width 53mm) is taken which is sketched using a Source Code in Microcontroller (ATmega32u4) that is embedded inside it. This Source Code is written for Servo Motor and Wi-Fi signal Enabling and Disabling. After sketching the Arduino Board it is fixed on the Door behind the locker. The power Supply of 5V to the board is supplied through USB cable from nearby Switch Board. In Arduino Board Wi-Fi is inbuilt so need of embedding any Wi-Fi Shield on it.

2. Servo Motor

The servo Motor is also fixed behind the door locker and it is connected using wires from the Arduino Yun Board. The Servo is connected using three wires for Data Transfer which is connected in Digital Pin 9, and then remaining two pins are connected to the Ground and Power (V_{cc}). The shaft which is located on the top of the servo motor is connected to the locker using wire, in order to perform the rotation according to the queries from the Arduino Board.

3. Android Apps

In the User Side (Mobile, Laptop or Tablet), the Android Apps for transferring a queries is installed and it passes the queries through Wi-Fi to the Arduino Board. The Arduino Yun Board which is located in a particular Distance reads the Wi-Fi Signal as either '0' Or '1'. The Android Apps contains two Options like Lock and Unlock. If the user presses Lock button in a Particular Device(Mobile or Laptop), the Wi-Fi signal travels towards the Arduino Yun and reads the signal as 1, which means it rotates the Servo Motor from 0° to 180° in Clockwise Direction which is shown in Fig.3 to Lock a Door. Suppose the user want to unlock a Door, the Unlock Button should be pressed and signal is travels towards the Arduino Yun board which reads the signal as 0. This signal allows the Servo Motor to rotate from 0° to 180° in an Anti-Clockwise Direction in Fig.3. Finally the working of an entire architecture is shown in Flow chart.

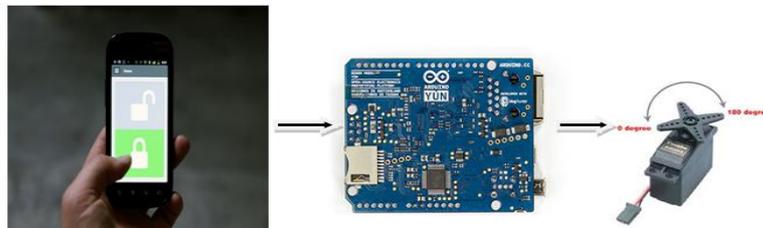


Fig.5. Passing signal to Arduino Yun Board

The Fig.5. Shows when the user presses the lock button signal from Wi-Fi module of a mobile phone reaches an Arduino Yun Board. Then the microcontroller from Arduino Yun Board allows the signal to travel towards the servo motor. The servo motor receives the signal and performs locking and unlocking operation. The functions of the each system components are represented in Table.1.

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Table.1 System Components Functions

No	System Components	Functions
1	Arduino Yun Board	Data Processing Unit
2	ATmega32u4	Controls the operation
3	In Built Wi-Fi	Receives Data Signal
4	Battery or Adaptor	Supplies Power to Board
5	Servo Motor	Locks and Unlocks door
6	Android Apps	Contains the commands

Flow Chart

The Flow chart contains both the performance of Android apps and the Arduino Yun Board. Initially the apps are enabled and allow the Wi-Fi to send the signal towards an Arduino Wireless LAN module. The wireless LAN module reads the signal and passes towards the microcontroller. After reading the signal, if Signal is '1' it allows a servo motor shaft to rotate in clockwise Direction and door locks. Then the process is stopped and sends the message to an android app that door is locked. If the signal is '0', it allows a servo motor shaft to rotate in Anticlockwise Direction to unlock Door. Finally it sends an Acknowledgment to the Mobile or Laptop Android Apps.

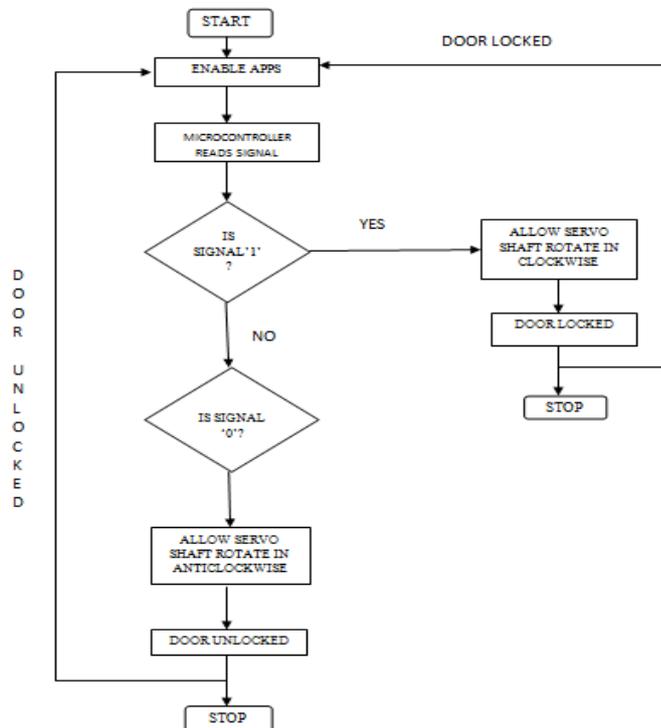


Fig.6. Flow Chart of Overall System

IV. SOFTWARE PLATFORM

The Programming Language used in Arduino Yun Board is based on C Language which is sketched in Arduino Open Source IDE 1.0.5 [11] and it works on Windows, Mac and Linux Operating Systems. In this IDE Wi-Fi Library and UDP support are available which makes a user to broadcast the data without any TCP connections. It also supports for Arduino Robot and TFT screen and allows compiling a program to the ARM processor. It holds number of default libraries for performing many applications in Arduino board. Another End, Android application [12] is developed using Android Development Tools (ADT) and Android Software Development Kit (SDK) which is an opens source for application development.



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V. RESULT ANALYSIS

After the completion of a task, the result is analyzed which is more efficient output by using Wi-Fi compared to existing work. The signal from the mobile phone travels more than 100m. The user from anywhere inside the home is allowed to operate the door without moving closer to the door. Wi-Fi connects to the internet through a stationary access point. An "access point" is an extra piece of equipment that Wi-Fi generally requires to allow devices to connect and work together. This work is more useful for the Handicapped person who can't work for a longer distance. Here ATmega32u4 microcontroller which holds in built Wi-Fi allows the data rate of 600 mbps and 2.4 MHz frequency and it is more security compared to the existing Bluetooth (IEEE 802.15.1) and Zigbee (IEEE 802.15.4) technology with supports only shorter distance and less accessibility.

VI. CONCLUSION AND FUTURE WORK

The end result of this project is ended up successfully with both unlock and lock capability of door by an android application and also by an Arduino Yun Board. The Wi-Fi allows the user to interact with the Board from longer range when compared to Bluetooth. The major advantage here is the usage of an Arduino Yun Board which is in under research for future purpose by many scholars. Further the overall system is more attractive which allows us to interact with the environment. In Future, this Arduino Yun project is further enhanced with GPRS for performing Locking and Unlocking operations from any locations.

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BIOGRAPHY

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