Pattern Recognition using IR

Abhimanyu Singh,YogeshKaswan

School of Electronicsand Communication Engineering, VIT University, Vellore, Tamil Nadu, India
School of Electronics and Communication Engineering, VIT University, Vellore, Tamil Nadu, India

Abstract— *This paper is aimed at developing an infrared pattern recognition module which can be implemented for enhancing security systems currently in use. This infrared recognition module recognizes the pattern drawn by an infrared torch, placed at a significant distance. The pattern drawn by the infrared torch is displayed on LED matrix once the movement of infrared torch is completed. Modifications like coded infrared transmission, miniaturized model implementation, smart adaptive learning algorithms can be used to improve the performance of the device as per required security purposes.*

Keywords—*µC (Micro-Controller), A/D (Analog to Digital Converter),EEPROM (Electrically Erasable Programmable Read-Only Memory),IR (Infrared), IC (Integrated Circuits), JTAG (Joint Test Action Group),LED (Light Emitting Diode), MIPS (Million Instructions per second), SRAM (Static Random Access Memory).*

1. INTRODUCTION

Touch screen, at present, is the most popular technology because of its simplicity, low cost and easy interfacing. This technology is about to replace the keypads, which are bulky and specific task oriented, rather than being a multi task oriented. However, this technology also has a drawback of reduced security because of limitation of being installed just above the display screen, the password or various key patterns being entered are easily recognized. In this system, an emphasis has been laid on using the infrared keypad system for the security purposes. At this stage, the development of an IR recognition module has been focused, which further can be modified to the extent of application in security field. In this system a simple IR torch is emitting IR rays and then through the photodiode matrix the pattern is recognized.

2. METHODOLOGY

An infrared torch is being used as a transmitter to develop pattern on a matrix of photodiodes that are arranged in the line of sight to the transmitter. The output received by photodiodes is then sent to the IC LM 324, Quad op-amp, for amplification as the received signal is very small and also the signals are converted to digital from analog. This amplified digital signal is then fed to micro-controller, i.e., AVR Atmega-32. Now, a set of combinations have already been stored in the micro-controller, if the pattern drawn matches with any of the stored combination, then the output will be displayed through LED matrix.

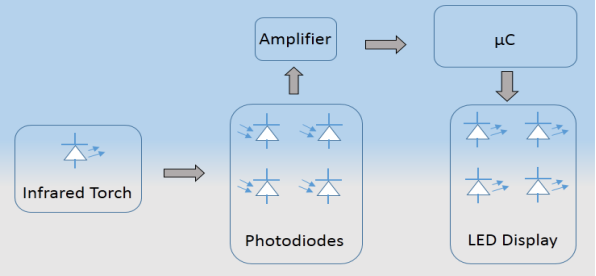


Fig:1 Block diagram of the system

3.Modules Included

3.1. AVR Atmega-32
Developed by Atmel in 1996, AVR microcontroller is an8-bit single chip microcontroller belonging to Reduced Instruction Set Computer architecture. The prominent features of AVR ATMEGA-32 are high-performance, low-power consumption.This microcontroller combines 32KB of programmable flash memory, 1KB SRAM, 512B EEPROM, an 8-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. The device supports throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts[1][6]. Atmega32 is shown in Fig. 2

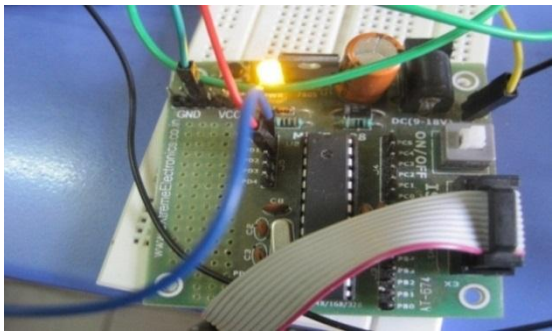


Fig.2 AVR Atmega-32

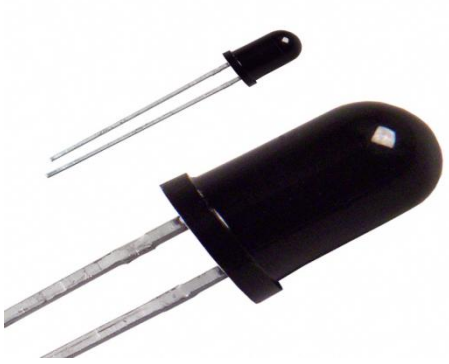
3.2. IR Transmitter
IR stands for infrared. The IR transmitter is set to work at a wavelength of 940nm. This wavelength falls under Near-Infrared region (NIR) of the IR

spectroscopy which ranges from 800nm to 2.5µm. The IR transmitter works at forward current of 100mA and maximum forward voltage of 1.4V. It works under line of sight condition with a viewing angle of 10º. It operates within the temperature range of -25ºC to 85ºC.Radiant Intensity of IR transmitter is 58mW/Sr and has a Turn On time of 25ns and Turn Of f time of 13ns[2]. The IR Transmitter is shown in Fig.2

Fig.3 IR Transmitter

3.3.Photodiode

Photodiode is a type of photo-detector capable of converting light into either current or voltage, depending upon mode of operation. Photodiode used has a lamp size of 5mm and has a wavelength of peak sensitivity of 850nm. It has maximum reverse of 50V and dark current of 1nA.It has a sensitivity of 0.62A/W and rise time of 0.005µs. The operating temperature range is -40ºC to 100ºC[3]. The Photodiode is shown in Fig.3



.

Fig.4Photodiode

3.4.LM 324

LM 324 consist of four independent high-gain

frequency-compensated operational amplifiers that are designed specifically to operate from a single supply over a wide range of voltages. Operation from split supplies also is possible if the difference between the two supplies is 3V to 32V, and Vcc is at least 1.5V more positive than the input common-mode voltage. The low supply-current drain is independent of the magnitude of the supply voltage[5].LM 324 is shown in Fig.4

Fig.5LM 324

4. Design

4.1.Analog to Digital Conversion

To convert the output voltage generated from photodiodes to digital form, differential configuration of the operational amplifier is used. The formula used to calculate the output voltage is:

$$V_o = A(V_1-V_2) \qquad \ldots(1)$$

Where,Vo is the output voltage, A if the open loop gain, V1 and V2 are the voltage at terminal 3 and 2 of the op-amp respectively.

4.2. Receiver Circuit

To design the receiver circuit, the photodiodes are placed at small distance such that they can perform independently. The distance between photodiodes for proper functioning also depends on the distance of operation of IR torch.

5. Result and Discussion

In the system developed, the torch movement is easily recognized by the photodiodes. The output generated at the photodiode end is amplified and converted into digital output. This digital output is then fed directly into the microcontroller and as per the case match the output is displayed on the LED matrix.

6.Conclusion

With the increasing risks of security breaching, it is very much necessary to find an alternate way to increase security of devices/safes. For this application, the IR pattern recognition system can be very useful as in most of the systems the pattern displays as soon as we start drawing the pattern but here as we are using infrared to draw pattern it will be difficult to have any idea of the pattern unless it is displayed on the LED matrix and that will only be possible if the pattern drawn is correct. So, by using this system security can be enhanced.

Modifications like smart algorithm, miniaturized models, coded infrared transmission can be used to improve the performance.

7. Acknowledgment

This work was supported by School of Electronicsand communication engineering, VIT University. The authors would like to thank Prof. Sugumaran S, Prof.Jabeena A, for their guidance and inspiration, the Director, SENSE and the management of VIT University, Vellore for providing the facilities to carry out this study.

REFERENCES

[1].http://www.researchgate.net/journal/0218-0014_International_Journal_of_Pattern_Recognition_and_Artificial_Intelligence
[2].http://www.academicpub.org/pris/
[3].http://uk.farnell.com/knowledge-on/kel5002a-a/ir-emitter- 5mm-940nm/dp/4890929
[4].http://uk.farnell.com/osram/sfh213/photodiode-850nm-10-t-1-3-4-5mm/dp/1212761
[5].http://www.vishay.com/docs/81502/bpv10.pdf
[6].www.ti.com/product/lm324
[7]. www.wikipedia.org
[8]. http://www.maxembedded.com