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Virtual 3D Touch Interface using Obstruction Detection

Narendran Seenivasan[1], S. Sankar2
[1, 2]*Computer Science and Engineering, Erode Sengunthar Engineering College*

Abstract: Virtual 3D Touch interface using Obstruction Detection. This project is based on the simple burglar alarm technique. It involves detecting the orientation of objects inside consecutively arranged 2D sensor frames and mapping those data matrix to world co-ordinates of the objects inside the system (computer, animation world, hologram). This process imitates the touch screen or data glow usage but with one astonishing fact that it can detect everything within the frame and those actions can be used as inputs to system.
Keywords: Air Touch – 3D virtual touch interface, Pixel – A point where the both obstruction beam crosses, Sensor frame – Square of horizontally and vertically aligned obstruction detection sensors.

I. INTRODUCTION

Types of input interfaces ranges roughly from mouse to motion tracking sensors. Everything is used as an UI for systems. Mouse and touch pad is a scalar pointing input interface which is more used for daily purpose, while stylus and touch screens are more effective for leisure activities with hand held devices. To use at ease, people have to rely on data glow when it comes to 3D modelling, VR or AR interactions. Data glow technology is very efficient and simpler way to interact with holograms, AR and VR but with limitations. The main disadvantage of the data glow technology is that one should wear the glow for interactions. Air touch gives a way to interact with 3D objects with any wearable devices with the user. It can recognize multiple touches, gestures, 3D vectored motions, and even it can be used to quantify the object inside the touch frame. The 3D data matrix is analysed to get the input data.

II. SIMPLE PROTOTYPE

A prototype of the Air Touch is based on the obstruction detection using IR sensor. It can even be added with image processing works to get full potential of Air Touch. Two perpendicularly fixed IR sensors make up a pixel in a frame. Simple IR sensor can be made with following components. Images are adapted from maxembedded.com. The components are described below.

A. IR Transmitter

IR LED as shown in Fig.1, is a simple Light Emitting Diode which emits Infrared rays on passing electric current while forward biased. IR LED is the source of required IR rays. IR LED is given +5V DC supply across a resistance of 150 ohm at its negative terminal. This setup will make the IR LED to emit IR waves continuously.

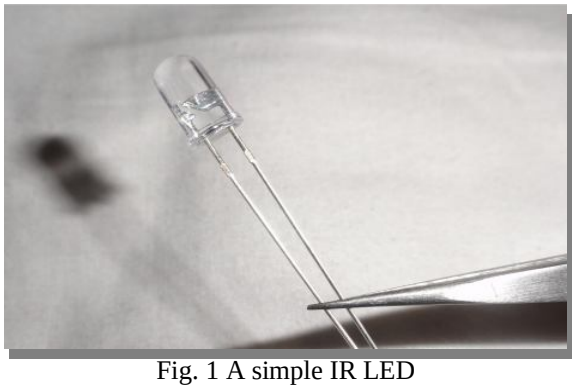

Fig. 1 A simple IR LED

B. Photodiode

A photodiode, as shown in Fig. 2, is a light dependent resistor which loses it resistivity while IR rays are falling on it. It is reverse biased with +5V at negative terminal across a resistance on 10 Kohm. This setup is made to absorb IR radiation produced by IR LED.

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Fig. 2 A simple IR Photodiode

C. Comparator

LM358 operational amplifier, as shown in Fig. 3, is used as a logical comparator. It is used as a comparator which checks the input voltage whether it is higher or lower than the threshold value. If the input is higher than threshold, it returns +5V (logical 1) as output else 0V (logical 0) as output. A single LM358 has two comparators which are required for a single pixel as it has 2 beams.

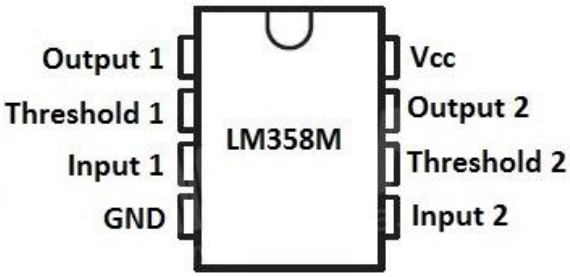

Fig. 3 A logical comparator

D. Circuit

The overall circuit as shown in Fig. 4, of a simple IR sensor required for a single beam of a pixel. This circuit features a digital IR Sensor as it gives output as binary. The output given by the sensor is inverted. If the beam is present, it will give output as logical 1. If the beam is interrupted, it will give output as logical 0. These outputs belong to a single beam. The outputs of perpendicular beams should be taken to get output of a single pixel.

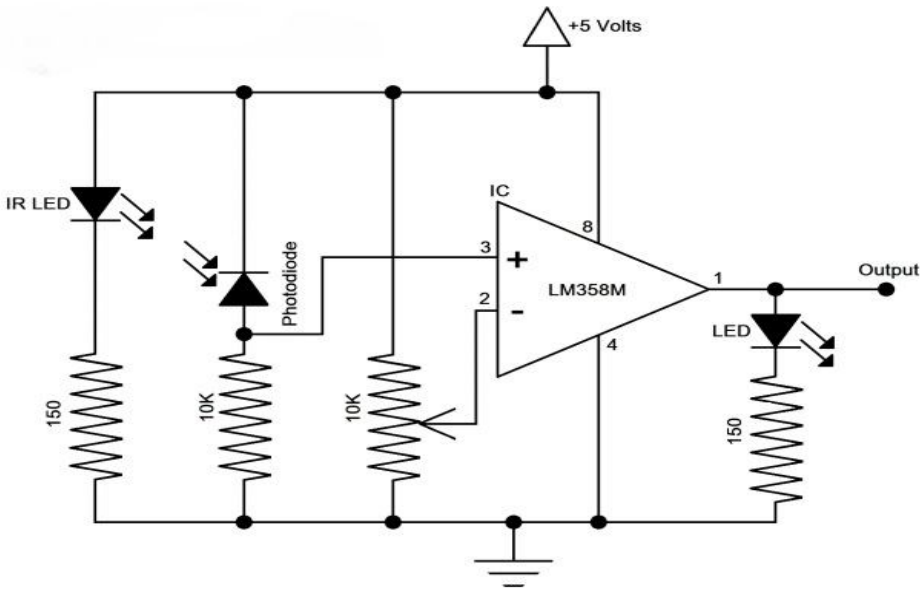

Fig. 4 The circuit diagram for single IR Sensor

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E. Parallel to Serial Conversion

The data given out of each pixel should be transferred to the computational unit. A computational unit can be anything like microcontrollers, Arduino chips, Raspberry pi etc as per the cost required by the customer. For safe transfer, the data is converted to serial data. The sampling rate determines the smoothness of the UX. The data is mapped as 3D matrix which has 1's and 0's that represent the activation of pixels. This is the required raw data for computation. Optionally data from image processing unit can also be used to increase the capability and accuracy of Air Touch. The transmission phase will differ for different computation device.

III. METHODOLOGY

The IR LED is powered up and the IR beam is made to fall on photodiode. This pair makes a IR sensor. It detects obstruction and give logical 0. These IR sensors are fitted horizontally and vertically along the wall of a room or a frame. When fitted, each of the vertical IR beam crossed the horizontal IR beams perpendicularly. While crossing, it makes a point where the both beams crosses. These points are nothing but the pixels. Number of pixel is equal to the product of vertical IR sensors and horizontal IR sensors. Increasing the sensors, increases the pixels and in turn it increases the resolution of the Touch. This setup is considered as a frame. These frames are consecutively fixed along the third axis of the hall to make 3D touch interface.

Vertical IR sensors' outputs are coupled with horizontal IR sensors' outputs to achieve the single output which says whether a pixel is selected or not. It returns logical 0 if the pixel is selected and logical 1 if it is not selected. These data are inverted to make the selection of a pixel returns logical 1. Then the data is converted to serial data with required baud rate using Parallel to Serial conversion registers. The data are sent into system by USB. The controller program detects the input port and reads the data from the data stream to process according to motion, or gesture etc. Then the resultant reaction data is sent to the required Application Program interact with the virtual object just as any other input interface technologies.

IV. RESULT

Pixels density may be increased using LASER like coherent source of IR beams which will be more resistant to interference and it can reduce the size of IR sensor. If the IR sensors are made tiny, it increases the resolution of the Air Touch. Using slightly frequency varying IR channels to nearby sensor will eliminate interference. At very high resolution, it can be used as a motion detection technology which can detect the complete state of the object which are inside the 3D frame. Image processing with Skelitron will increase the efficiency and unlock full potential of Air Touch.

V. CONCLUSION

This technology will hit the market at great demand when its couple technology, Hologram is introduced. This technology could be incremented with image processing, which will ultimately extend the Air Touch to open environment where IR may get interfered with Sun's IR. This is the efficient way to monitor the motion or gesture of hands to get those as inputs. It will increase the CAD modelling, AR and VR work, and Entertainment.

VI. ACKNOWLEDGMENT

We would like to thank our colleague Gowtham P for his excellent advice, motivations and animation works regarding Air Touch. He is the motivation for us when we meet failures and lags.

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[1] Digital IR sensor is adapted from maxembedded.com. Link: https://www.maxembedded.com/2013/08/how-to-build-an-ir-sensor/

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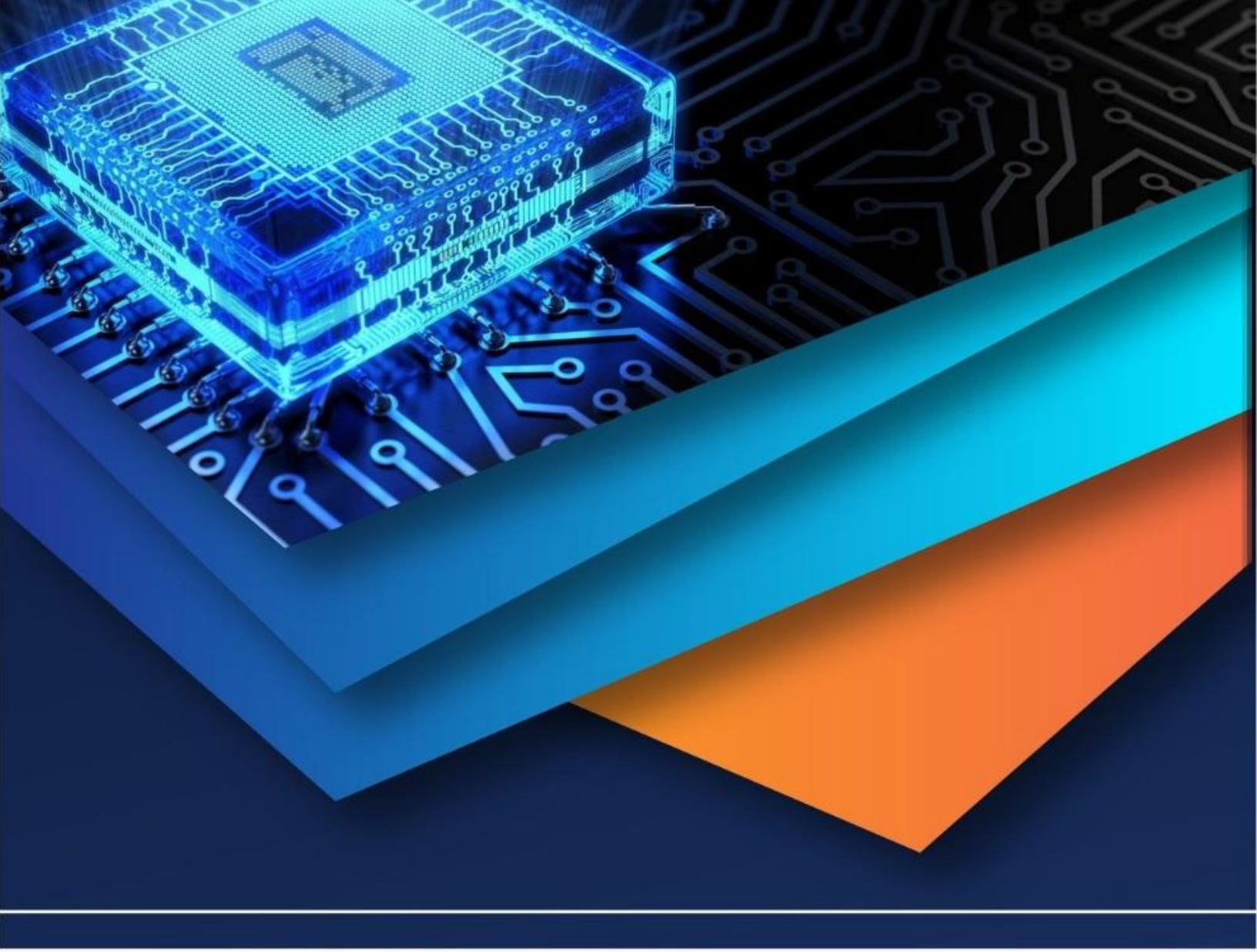

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