

# Intrusion Detection and DC Motor Controlled Wireless Firing Unit for Border Security

Ms. T. Sowmya<sup>1</sup>, Ms. G. Sravya Lekha<sup>2</sup> & Mr. P. N. N. K. Bhargav<sup>3</sup>  
<sup>1,2,3</sup>Electrical and Electronics Engineering, Pragati Engineering College, Surampalem

**Abstract:** In this paper, the conventional Automatic Firing Unit (AFU) based border security gives accurate firing rate but there is a chance of firing a person who is not an intruder. So in the proposed controlling the drawback of the conventional AFU is effectively overcome by the proposed control. The Pyro-electric Infrared (PIR) sensor is arranged in the border where security is the main priority. The Zigbee module transmits the video data to a receiver equipped in the main control room. Video will be used to adjust the laser to intruder and the firing will be done from the Control room. So, the proposed control is more effective compared to the conventional control. Graphical User Interface (GUI) and Radio Audio Video Receivers are mainly used for firing unit controlling.

**Index Terms—** AFU, Zigbee, PIR sensors, GUI, Radio AV receiver

## 1. Introduction

In many countries their border security is the primary aspect. To save their country they have to go for very much advanced and efficient controlling methods for border safety. This paper presents a novel computer-controlled intrusion detector [1] which may be used for the surveillance of borders, either of a country, or of areas requiring high security, especially in regions of extreme climatic conditions, where it is difficult to deploy personnel. This system not only detects intrusion but also provides a video-coverage of the suspicious area, for remote vigilance, via communication system. Thus, several kilometers of the borders, which would have otherwise required several hundred personnel, can be effortlessly monitored with this system, with only a few personnel. As we see the video surveillance in control room, we can access the firing unit automatically. So we can aim and shoot the intruder from the control room itself. Since, the actual firing occurs only after an authoritative personnel has doubly confirmed the presence of an intruder, chances of firing at innocent people are completely ruled out. When an intruder entered the secured area he can be sensed by the sensors placed there and gives the video by putting wireless camera ON and makes us to use firing unit.

In this manner we can use the technology of the

border security without any precious life's. The authority at the control room is then facilitated a Real-Time video-coverage of the area under consideration, in order to provide scope for human-judging.

## 2. Automatic Firing Unit

The conventional control for border security is Automatic firing unit (AFU) with only horizontal position control. Whenever a person either an intruder or an innocent person comes across the area containing the firing unit setup will be undoubtedly fired when the person walks near it. When the person crawls after it, the security is ruined. So, such system presented in [2] doesn't give total protection. After firing the person there will be an intimation given to the control room through Global system for mobile communications (GSM).

So, there will not be complete protection and also may be chance of killing innocent people.

## 3. Main Idea

The main idea of the paper is to give accurate, effective and efficient border security which can be achieved through DC motors. DC motors are used in the firing unit in order to get vertical and horizontal area control. DC motors are widely used for their better dynamic response and low cost. The firing setup is arranged where surveillance is required. Whenever a person enters the secured region, Pyro-electric Infrared (PIR) given in [3]-[4] senses the person and activates the Zigbee device. The zigbee device sends the video coverage to the control room and the computer controlled operation is done whether to fire the person confirming as intruder or innocent. If the person is confirmed as an intruder as confirmed from the video coverage seen in the control room, the controlling person will give the command to the firing unit from zigbee device [5],[6] through a GUI program in the computer.

## 4. DC Motor Based Wireless Firing Unit

There has been a prototype designed in order to fulfill the above mentioned idea. The main block diagram of the whole setup is as shown in the Fig. 1. The block diagram contains the main component

micro controller, Zigbee module, PIR sensor, PC, motor driver [8], motors etc.

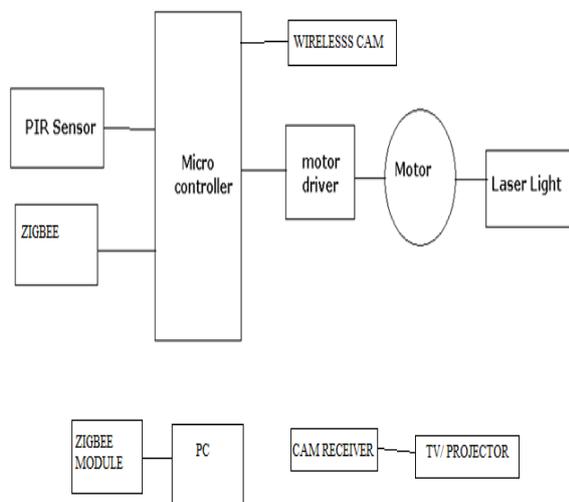


Fig. 1 Block Diagram

The PIR sensor senses the intrusion and gives a signal to the microcontroller [7]. The Microcontroller used in the prototype is AT89S52 [7]. The microcontroller thus activates the Zigbee module. The zigbee module gives video coverage to the Audio Video Trans-receiver [9]. By using the video coverage controlling person can control the DC motor operation done by motor driver. The accurate position of the firing unit can be controlled by using the GUI based program.

The GUI program used for the controlling of the firing unit is as shown in the Fig.2. When an intruder is detected the zigbee will activate the video coverage in the control room and from the control room the GUI is operated as, intruder is detected will be displayed and the position of the firing unit can be controlled both in horizontal and vertical positions in order to cover the whole area of security. By clicking the 'M-LEFT' and 'M-RIGHT' the firing unit can be controlled for horizontal targeting and by clicking 'CAM-U' and 'CAM-D' the vertical targeting is achieved. After pointing to the target (intruder), the target will be fired by clicking 'LASER'. 'CAM ON' and 'CAM OFF' are used to switch on the video coverage of the secured area for checking purpose.

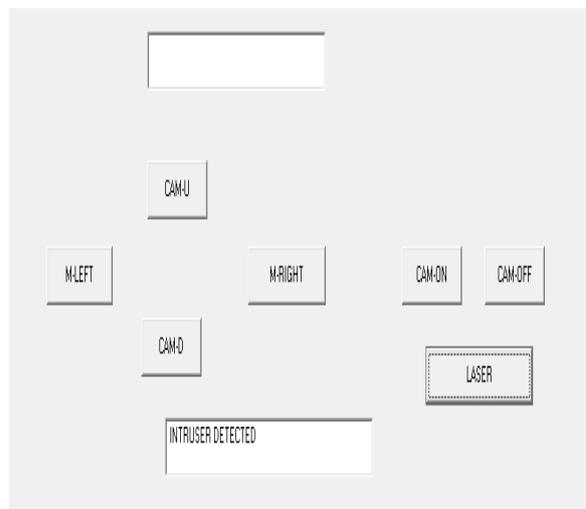


Fig.2 GUI [10] program

As shown in the block diagram, the equipments are connected as shown in the Fig. 3. Fig.3 shows the schematic diagram.

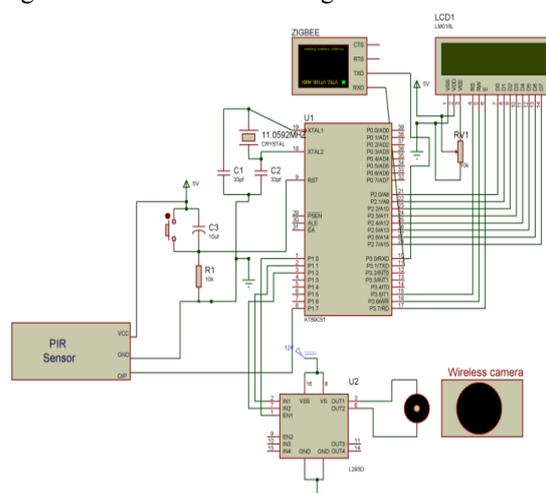


Fig. 3 Schematic Diagram

The firing unit is as shown in the Fig. 4.



Fig. 4 Firing Unit

The whole setup gives a very much effective and efficient controlling. Many people are dying due to terrorist's attacks as they are entering our country. Our border security fails in cases of rough terrains as it is being difficult for surveillance manually. As our technology is being well developed, we can use technology for the border security instead of manual surveillance. This paper describes a novel computer-controlled intrusion-detector which may be used for the surveillance of borders, either of a country, or of areas requiring high security, especially in regions of extreme climatic conditions, where it is difficult to deploy personnel.

This system not only detects intrusion but also provides a video-coverage of the suspicious area, for remote vigilance, via a satellite based communication system. Thus, several kilometers of the borders, which would have otherwise required several hundred personnel, can be effortlessly monitored with this system, with only a few personnel. As thermal cameras are used for imaging, this system is immune to changes in ambient conditions, and therefore, is equally suited for operation during the night. This paper also throws light on the prototype of this system, which has been successfully developed.

Generally, video surveillance couldn't alone give the security. So in order to provide security we are using a firing unit along with surveillance camera. As we see the video surveillance in control room, we can access the firing unit automatically. So we can aim and shoot the intruder from the control room itself. Since, the actual firing occurs only after an authoritative personnel has doubly confirmed the presence of an intruder, chances of firing at innocent people are completely ruled out. When an intruder entered the secured area he can be sensed by the sensors placed there and gives the video by putting wireless camera ON and makes us to use firing unit.

In this manner we can use the technology of the border security without any precious life's. The authority at the control room is then facilitated a Real-Time video-coverage of the area under consideration, in order to provide scope for human-judging. Upon ensuring that the cause of alarm is indeed an intruder, a fire command is sent to the Firing Unit (FU), which, based on the target locations determined by the DSP, automatically fires at the target. The FU is built out of a gun-turret equipped with DC motors to facilitate accurate three-dimensional motion.

## 5. Hardware Equipment

Type In the hardware design the main components used are:

- Power supply unit.
- Microcontroller.
- Motor driver.
- DC motors.
- PIR sensors.
- Wireless Camera.
- Zigbee module.
- Firing Unit.

### a) Microcontroller:

The main function controlling in the whole prototype is mainly done by using the microcontroller AT89S52 [7]. It is an 8-bit microcontroller. The AT89S52 provides the following standard features:

- 8Kbytes of Flash,
- 256 bytes of RAM,
- 32 I/O lines,
- Three 16-bit timer/counters,
- Six-vector two-level interrupt architecture,
- A full duplex serial port,
- On-chip oscillator and
- Clock circuitry

By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89S52 [11] is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications. It is provided with 40 pins.

The main operation of the microcontroller in the module is to give commands to the auxiliary parts like zigbee module, motor driver. Whenever an intrusion is detected, the PIR sensor will give signal through Zigbee device. So, the zigbee device will automatically give video information of the secured area under intrusion detection.

### b) Motor Driver:

Motor driver is one of the important components to drive the motor. Here we are going to use L293D motor driver. The L293D motor driver is available for providing User with ease and user friendly interfacing for embedded application. L293D motor driver is mounted on a good quality, single sided non-PTH PCB. The pins of L293D motor driver IC are connected to connectors for easy access to the driver IC's pin functions. The L293D is a Dual Full Bridge driver [8] that can drive up to 1Amp per bridge with supply voltage up to 24V. It can drive two DC motors, relays, solenoids, etc. The device is TTL compatible. Two H bridges of L293D can be connected in parallel to increase its current capacity to 2 Amp.

On receiving the command from the microcontroller the motor driver will drive the DC

motor accordingly by following the commands from the microcontroller. The controlling person from the control room will give necessary commands in the GUI program in order to shoot or fire the intruder. These commands will be transferred to the microcontroller through the Zigbee USB device. Upon receiving the necessary commands the microcontroller will control the motor driver accordingly. Motor driver will drive the DC motor.

### c) Pyro-Electric Infrared Sensor:

Compact and complete, easy to use Pyro-electric Infrared (PIR) Sensor Module for human body detection. It incorporates a motion detection circuit, high sensitivity and low noise. Output is a standard 5V active low output signal. Module provides an optimized circuit that will detect motion up to 6 meters away and can be used in burglar alarms and access control systems. Inexpensive and easy to use, it's ideal for alarm systems, motion -activated lighting, holiday props, and robotics applications.

The Output can be connected to microcontroller pin directly to monitor signal or a connected to transistor to drive DC loads like a bell, buzzer, siren, relay, opto-coupler (e.g. PC817, MOC3021). The PIR sensor and Fresnel lens are fitted onto the PCB. This enables the board to be mounted inside a case with the detecting lens protruding outwards.

#### Features:

- Complete with PIR, Motion Detection IC and Fresnel Lens
- Simple 3 connections
- Dual Element Sensor with Low Noise and High Sensitivity
- Supply Voltage: 5V DC
- Standard Active Low Output pin for connecting to microcontroller directly
- Detecting range up to 6 meters
- LED indication
- Module Dimensions: 25mm Length, 32mm Width, 25mm Height

Pyro-electric devices, such as the PIR sensor, have elements made of a crystalline material that generates an electric charge as given in [3] when exposed to infrared radiation. The changes in the amount of infrared striking the element change the voltages generated, which are measured by an on-board amplifier. The device contains a special filter called a Fresnel lens, which focuses the infrared signals onto the element. As the ambient infrared signals change rapidly, the on-board amplifier trips the output to indicate motion. The PIR sensor used is for 180° of operation. The operation is as depicted in

the Fig. 5.

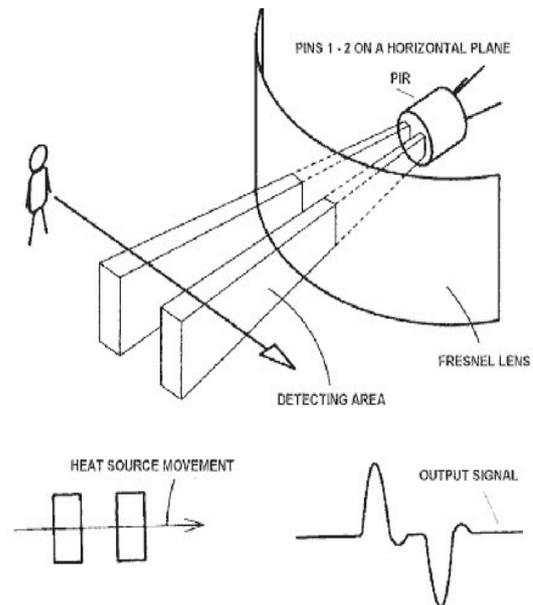


Fig. 5 Operation of PIR sensor

### d) Zigbee Device:

**Zigbee [6]** is a low power spin off of Wi-Fi. It is a specification for small, low power radios based on IEEE 802.15.4 – 2003 Wireless Personal Area Networks standard. Bluetooth and Wi-Fi should not be confused with Zigbee. Both Bluetooth and Wi-Fi have been developed for communication of large amount of data with complex structure like the media files, software etc. Zigbee on the other hand has been developed looking into the needs of communication of data with simple structure like the data from the sensors.

**Zigbee devices** can form networks with Mesh, Star and Generic Mesh topologies among themselves. The network can be expanded as a cluster of smaller networks. A ZigBee network can have three types of nodes: Zigbee Coordinator (ZBC), Zigbee router (ZBR) and Zigbee End Device (ZBE) each having some unique property. Let us understand Zigbee through a typical usage scenario in a home automation system. There can be only one ZBC in a network, the one that initiates the network in the first place and stores the information about the network. This would be the main control panel or remote control in the living room of each storey. All the devices in the network communicate with this ZBC. It has routing capabilities and acts as a bridge to other networks on other floors. A ZBR is an optional component used to extend the coverage, say, providing access to the Zigbee receivers controlling the garage lighting and shutter which is in the nearby shed. The router itself may host an

application like a CC Camera which is continuously in active monitoring state. It can also handle local address allocation or de-allocation. The whole operation of Zigbee can be seen from the Fig. 6.

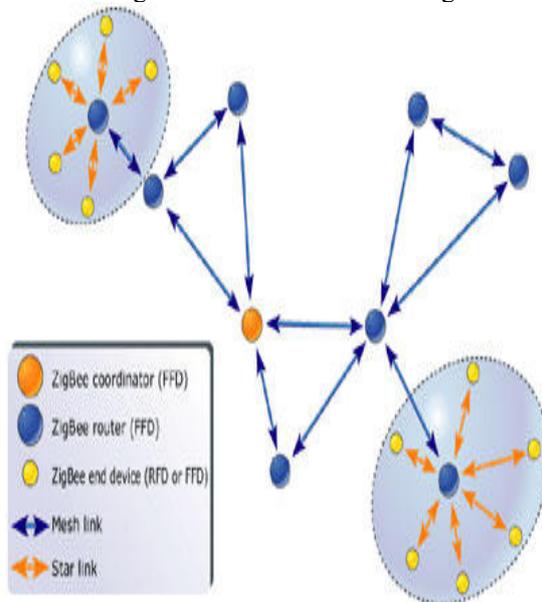


Fig. 6 Operation of Zigbee First-order Headings

## 6. Results and discussion

So, by comparing the performances of both the conventional control and the proposed control, the

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conventional approach does not give better results when compared to the proposed control approach.

Task	Conventional Control	Proposed Control
Horizontal Firing	Possible	Possible
Vertical Firing	Not Possible	Possible
Intruder Protection	Partial protection	Complete protection
Innocent Protection	No Protection	Complete Protection
Efficient and Effective Protection	Partial protection possible	Complete protection possible

Table. 1 Final Result

In the conventional control there is a chance of firing an innocent person and also there is only a horizontal automatic firing mechanism such that if the intruder crawl, he can be entered into the secured area. In the proposed control, there is a chance of clarifying the difference between intruder and innocent person. Also, 3-Dimensional firing control is possible in the proposed control. DC motor gives better controlling due to their better response under running condition. The overall results can be found in the Table. 1.

## 7. References

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