Non-Destructive Safety for Livestock and Humans using Arduino Uno

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***Abstract*— This paper describes an efficient module that can protect the animals especially livestock, domestic stray animals and also to detect the road accident before occurring, it can save human life. The main aim of this paper is to design an ultrasonic sound generator that could be used to warn the stray animals entering the road. Animals of similar size can hear the ultrasonic sound that human cannot. When the animals hears this high-pitched sound it gets an alert and leaves the place, through this accident can be minimized. If any obstacles or humans is present in front of the vehicles or coming from opposite direction, with the help of relay the speed of motor can be controlled automatically. Incase if the accident occurs, then our system generates a message through GSM. This module can be used to detect humans or animals including obstacles will certainly give us a better solution to reduce the death of humans in road crash.**

Keywords—Accident avoidance, speed control, ultrasonic sensor, PIR sensor and GSM.

I. INTRODUCTION

According to the WHO (World Health Organization) 2014 Global Status Report on Road Safety [1], road traffic deaths would become the fifth leading cause of death. The report showed that there had been no overall reduction in the number of people killed on the world's roads. About 1.24 million deaths occur annually. Among them cyclist, motorcyclists, car occupants & unspecified road users are high. Number of animals die in road accident is also quite high. Even in several countries the number is pretty high [2]. Someone is injured every 18 seconds. Over 2 million of those injuries turn out to be disabling. A person dies in a crash on U.S. roads every 11minutes. In fact, motor vehicle accidents are the most common cause of death in the United States more than cancer or heart attacks. When we think about the serious accident, it could change your life and not for the better [3]. Ultrasonic Sensing: Fundamentals and Its Applications to Non-destructive Evaluation [4]. The number of road accidents had increased sharply. Test Methods and Results for Sensors in a pre-crash detection system [5]. Wireless vehicular accident detection and reporting system [6]. Advanced accident avoidance system for automobiles [7]. Vehicle accident detection and reporting system using GPS and GSM [8]. Vehicle Accident Prevention System using GSM and GPS [9]. Traffic accident automatic detection and remote alarm device [10]. An automated traffic accident detection and alarm device [11]. Vehicle accident automatic detection and remote alarm device [12]. Automatic vehicle accident detection and messaging system using GPS and GSM modems [13]. Accident prevention and reporting system using GSM (SIM 900D) and GPS (NMEA 0183) [14].

II. PROPOSED SYSTEM

This paper describes an efficient module that can protect the animals especially livestock, domestic stray animals and also to detect the road accident before occurring it. The main aim of this paper is to design an ultrasonic sound generator that could be used to warn the stray animals entering the road. If any humans is present in front of the vehicles or coming from opposite direction, with the help of relay the speed of motor can be controlled automatically. Incase if the accident occurs, then our system generates a message through GSM (Global System for Mobile communication).

III. ACCIDENT AVOIDANCE

The Arduino Uno is a microcontroller board based on the ATmega328 (data sheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards [15].

A. Circuit description

The controller used in this paper is Arduino Uno. Two PIR sensors are connected to IO3 & IO4 bit. One tilt sensor is connected to sens0 bit. All these sensors give digital input that's why all these 3 pins are pulled down by 10K resistors.

Here all the VCC are +5v. IR sensors also consume +5v and both sensors are connected to IO0, IO1 bit. G module communicates with microcontroller through serial communication. Other pins are used to control the GSM modem. Relay is connected to Sens1 no pin. And Buzzer is connected with sens2 no pin. Here LM317T IC is used to generate 3.3v which powers the GSM module. Power of Arduino comes from USB. Circuit operation is simple.

First step is to detect human. There are three possibilities, human is at left side of the car, at the middle of the car or at right side of the car. If human is at left side only PIR1 will generate a high signal, if human is at the center both the PIR will generate high signal and if the person is at right side only PIR2 will generate a signal. According to the PIR a signal will be sent to turn the staring to avoid the human. If avoidance of obstacle is not possible then the tilt sensor will be get shorted and a +5v will go through sens2 pin. Block diagram for proposed system is shown in fig.1.

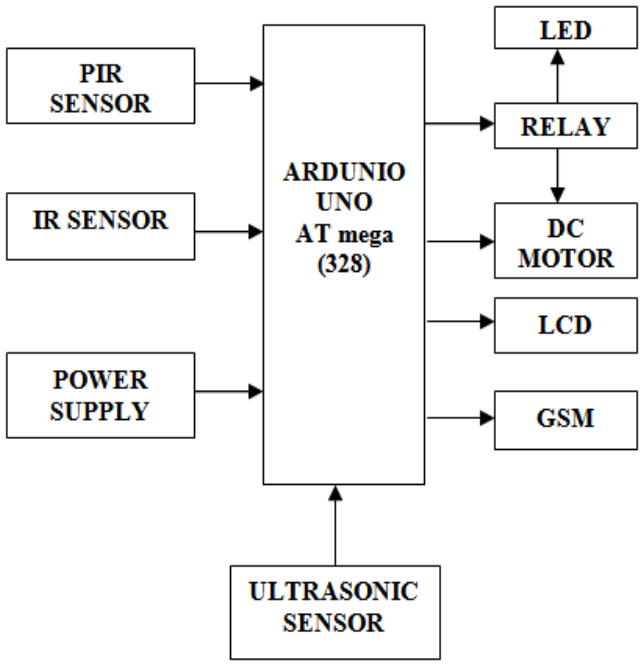

Fig. 1. Block diagram for proposed system

When microcontroller gets this signal it initiates an alarm and sends a tweet to internet through GSM module. We did not included GPS module for location tracking as there are several GSM modules are available in market to know the pin point location of car. Relay is used to disconnect the battery of the car while accident occurs. Lots of time spark from batteries ignite fire and cause severe damage. To avoid spark from battery relay is used to disconnect the positive terminal of battery. And buzzer also continuously indicates that accident has occurred and need emergency help. Tilt sensor measure any angle rotation around +15degre of -15degree which confirms the indication of accident.

B. Passive Infra-Red sensor

The PIR (Passive Infra-Red) Sensor is a pyro electric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects. This motion can be detected by checking for a high signal on a single I/O pin. Pyro electric devices, such as the PIR sensor, have elements made of a crystalline material that generates an electric charge 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.

Connect the 3-pin header to your circuit so that the minus (-) pin connects to ground or Vss, the plus (+)pin connects to +5 volts or Vdd and the OUT pin connects to your microcontroller's I/O pin. One easy way to do this would be to use a standard servo/LCD extension cable, available separately from Parallax. This cable makes it easy to plug sensor into the servo headers on our Board Of Education or Professional Development Board. If you use the Board Of Education, be sure the servo voltage jumper (located between the 2 servo header blocks) is in the Vdd position, not Vin. If you do not have this jumper on your board you should manually connect to Vdd through the bread board. You may also plug the sensor directly into the edge of the breadboard and connect the signals from there. Remember the position of the pins when you plug the sensor into the breadboard. Once the sensor warms up (settles) the output will remain low until there is motion, at which time the output will swing high for a couple of seconds, then return low. If motion continues the output will cycle in this manner until the sensors line of sight of still again.

The key of this Paper is Human sensing technology. In this paper passive infra-red sensor has been used to detect human. Infrared radiation exists in the electromagnetic spectrum at a wavelength which is longer than visible light. It can be detected though it cannot be seen. Objects that generate heat also generate infrared radiation and those objects include animals and the human body whose radiation is strongest at a wavelength of 9.4um. PIR sensor is able to detect the change of radiation of this infra-red radiation. PIR sensor generates +5v and -5v sine signal when any human or animal passes in front of the sensor or any movement is detected of human or animal in front of this. A breakout board is used to detect this signal and convert it into a longer digital signal. A picture of working principle of PIR sensor is shown in fig. 2.

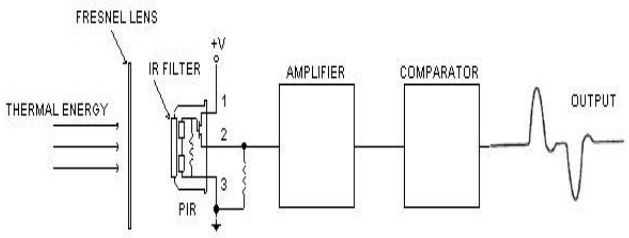

Fig. 2. Typical configuration of PIR

The output of PIR sensor can be adjusted. For max it can create an output signal for approximately 1.2 seconds. This is more than enough to detect the signal facing the IR sensing element so that a smooth surface is presented to the subject side of the lens which is usually the outside of an enclosure that houses the sensor. The lens element is round with a diameter of 1 inch and has a flange that is 1.5 inches square. This flange is used for mounting the lens in a suitable frame or enclosure. Mounting can best and most easily be done with strips of Scotch tape.

Detection area of a PIR sensor is 3m in width, 5m in length & 3m in height. But on average the width of any car is around 1.5m [5]. We have to detect humans or animals within this width. So, we have covered the lens area to reduce the width to 1.5m. Reduced with of PIR is shown in fig.3.

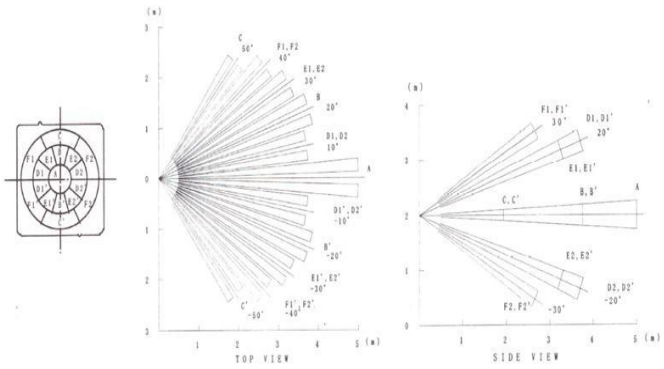

Fig. 3. Reduced with of PIR

C. Accident avoidance system

An advance pre-crash system is also capable to avoid accident by sensing human and their distance from vehicle. For example an automated braking force can be executed in this system. Moreover, the system can handle the steering by determining the position of human or obstacle. If driver forgets to press horn then the system can also generate an auto horn to indicate the person in front of the car [8]. According to the WHO 2013 Global Status Report on Road Safety, road traffic deaths would become the fifth leading cause of death. The report showed that there had been no overall reduction in the number of people killed on the world's roads: about 1.24 million deaths occur annually. Among them cyclist, motorcyclists, car occupants and unspecified road users are high. Number of animals die in road accident is also quite good. Even in several countries the number is pretty high.

These systems have the ability to detect obstacles but the most important to detect human being or animals and avoid them are missing [2]. This sensing technology can reduce a large number of bikers, cyclist and passerby death. There are also lots of research work is available on accident avoidance, crash detection and alarm system. These methods uses break system, windows close, seat belt stiffen to save life from the accident but if the obstacle is human or animal then our system uses avoidance system also. If avoidance is not possible and accident happens then this system generate an SMS, also internet based alert through GSM module only, including tracking the position of accident using GSM [5]. Human detection using PIR Sensor is shown in fig.4.

Fig. 4. Human detection using PIR Sensor

D. Ultrasound generator

The ultrasound generator is basically a transmitter that transmits the ultrasound in the surrounding using air as medium and also this ultrasonic generator acts as the repelled for dogs. This will generate a frequency of 40 kHz which is irritating frequency for the dogs that humans cannot hear.

The block diagram the whole setup of the ultrasonic generator, here the circuitry of the transmitter involves the 555 timer that works as the Astable Multivibrator of frequency 40 kHz and the transmitter is used to transmit the ultrasound waves in the surrounding [4]. The prototype is connected to the loudspeaker that is loud enough. The block diagram of ultrasonic sound generator is shown in fig.5.

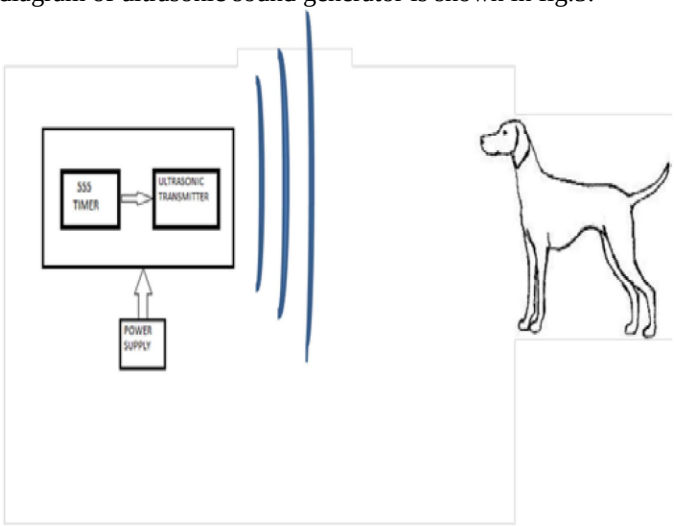

Fig. 5. Block Diagram of Ultrasonic sound Generator

The prototype is connected to the loudspeaker that is loud enough. When the dog hears the waves this help to distract them or encourages them to go away from there. This model helps us to prevent the road accidents to the maximum extents that are caused due to the animals. This structure is used as disincentive for the prevention of the accidents even in the forest guards also by adjusting the frequency of the timer for the propagation of the waves in the surrounding by placing this module at particular distance in the sides of the

highway roads, so that no animal can enter the road and therefore the accidents can be reduced. Through this the safety of the animals are also taken care. The percentage of the death of the animals due to accidents due to careless drivers or due to some climatic problems, this model can prevent this and save animals by transmitting the sound that encourages them to leave the place or the region when it hears.

This module is tested by decreasing the frequency and with a loudspeaker for transmission and the staggering. The power consumed by this module is also comparatively very less and this can be powered through the solar panels. The automatic switching of this module is possible using the sensors which alternately save the power consumption of the circuit. This module can also be powered with the lead-acid batteries as an alternative.

E. IR sensor

Infrared waves are not visible to the human eye. In the electromagnetic spectrum, infrared radiation can be found between the visible and microwave regions. The infrared waves typically have wavelengths between 0.75 and 1000µm. The wavelength region which ranges from 0.75 to 3µm is known as the near infrared regions. The region between 3and 6µm is known as the mid-infrared and infrared radiation which has a wavelength greater higher than 6µm is known as far infrared.

Infrared technology finds applications in many every day products. Televisions use an infrared detector to interpret the signals sent from a remote control. The key benefits of infrared sensors include their low power requirements, their simple circuitry and their portable features. The Foundations of Infrared Science Infrared radiation was first discovered by the astronomer William Herschel. He conducted an experiment in which he used a prism to refract light from the sun. Herschel was able to detect the presence of infrared radiation beyond the red part of the visible spectrum using a thermometer to measure an increase in temperature. The IR Sensor operation is shown in fig.6.

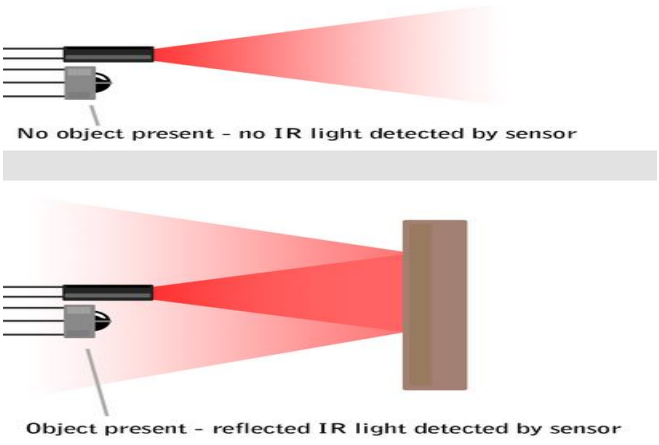

Fig. 6. IR Sensor operation

The Working Principle of Infrared Sensors all objects which have a temperature greater than absolute zero (0 Kelvin) posses thermal energy and are sources of infrared radiation as a result. Sources of infrared radiation include blackbody radiators, tungsten lamps and silicon carbide. Infrared sensors typically use infrared lasers and LEDs with specific infrared wavelength as sources.

F. Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switch. Relay allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

G. Location tracking without GPS

GSM (Global System for Mobile communication) is a digital mobile telephone system that is widely used in many parts of the world. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. GSM operates in the 900MHz, 1800MHz, or 1900 MHz frequency bands.GSM has been the backbone of the phenomenal success in mobile telecoms over the last decade. Now, at the dawn of the era of true broadband services, GSM continues to evolve to meet new demands. One of GSM's great strengths is its international roaming capability, giving consumers a seamless service. This has been a vital driver in growth, with around 300 million. In the Americas, today's 7 million subscribers are set to grow rapidly, with market potential of 500 million in population, due to the introduction of GSM 800, which allows operators using the 800 MHz band to have access to GSM technology too.GSM together with other technologies is part of an evolution of wireless mobile telecommunication that includes High-Speed Circuit-Switched Data (HCSD), General Packet Radio System (GPRS), Enhanced Data GSM Environment (EDGE), and Universal Mobile Telecommunications Service (UMTS).GSM security issues such as theft of service, privacy, and legal interception continue to raise significant interest in the GSM community. The purpose of this portal is to raise awareness of these issues with GSM security [16].

The mobile communications has become one of the driving forces of the digital revolution. Every day, millions of people are making phone calls by pressing a few buttons. Little is known about how one person's voice reaches the other person's phone that is thousands of miles away. Even

less is known about the security measures and protection behind the system. The complexity of the cell phone is increasing as people begin sending text messages and digital pictures to their friends and family. The cell phone is slowly turning into a handheld computer. All the features and advancements in cell phone technology require a backbone to support it. The system has to provide security and the capability for growth to accommodate future enhancements. General System for Mobile Communications, GSM, is one of the many solutions out there. GSM has been dubbed the "Wireless Revolution" and it doesn't take much to realize why GSM provides a secure and confidential method of communication.

Location tracking without GPS As all of us think that without GPS locating any object is not possible, but this information is not valid anymore. By the help of unique code, broadcast by each BTS tower it is possible to get the location of any GSM module at about certain limit of acceptability. Of course the location provided by this method is not as accurate as GPS data, but still its error margin is small enough to consider.

The controller used in this paper is ATMEGA328. Two PIR sensors are connected to PORTB0 & PORTB1 bit. One tilt sensor is connected to PORTB1 bit. All these sensors give digital input that's why all these 3 pins are pulled down by 10K resistors. Here all the VCC are +5v. GSM module communicates with microcontroller through UART.

IV. RESULT

A. *Experimental results*

This model is tested and the results are tabulated as shown in the below table

TABLE I. Experimental result

Number of dogs	Number of dogs responded	Percentage of success
10	9	90%

The result of hardware output is shown in fig.7.

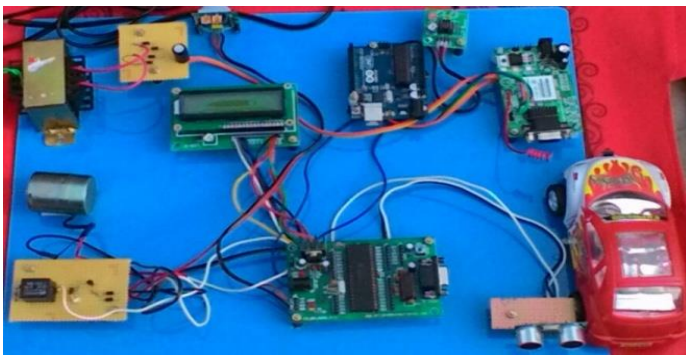

Fig.7 . Hardware output

B. *Advantages*

- In case of emergency the speed of the motor can be controlled.
- It reduces succumbed.
- The cause of accident can be minimized.
- Low expensive.

C. *Application*

- Avoiding Helicopter collision with bird.
- It is used in seaways.
- It is used in forest area.
- It is used in rural and urban areas.

V. CONCLUSION

The primary goal of this report is to sense and protect the humans and animals before the road crash. Passive infrared sensor and ultrasonic sensor is a reliable solution for detecting the both humans and animals respectively. This technique certainly can save lots of life. Both humans and animals life are valuable .Pre-crash detection system must be equipped with combination of two different sensors (Ultrasonic sensor and PIR sensor). Detecting humans and animals including obstacles will certainly give us a better solution to reduce the death of humans in road crash.

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