ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 3, March 2018

Animal Sensing Using Smart Sensors and Intimation over Wireless Gears

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ABSTRACT:During the medieval times, the Plantation workers and by-passers were prone to attacks by savage wild animals while trying to work in plantations. The animals were driven towards the plantation due to man's interference with the wild. It was not the animal's fault entering the plantation. According to Comptroller and Auditor General of India report on Economic Sector, the total number of wild animal attacks on humans during the period of 2012-2015 is 166 including the 133 by elephants for the year 2015. For every consecutive year, the number of such incidents have risen by the number of 5 - 15. Prevention of unnecessary Human and Animal deaths can be achieved through our more elegant and efficient methodology of placing the sensors throughout the plantation at selected places so that they detect the stray animal movement using PIR Sensors and body temperature using IR temperature Sensor. The Temperature Sensor's resultant output data is transmitted to the Local Base Station to be processed & scrutinized with previously collected datasets and to provide prior intimation to Plantation Worker's Personal Gadget of Animal's presence. This project pitches on the safety of both the mankind & the animal kind and takes a humanitarian problem persistent with plantation workers and has provided a foolproof solution to handle the worker's safety concerns as well as ensuring the protection of animals. This project can be implemented on a large scale to service plantation workers across the globe.

KEYWORDS:plantation; animal; human; PIR Sensor; IR temperature sensor; body temperature; local base station; gadget

I. INTRODUCTION

A plantation is a large-scale cultivation of cash crops. Commercial plantations are established to produce a high volume of wood in a short period of time. In India rubber is cultivated in a large scale where India is the 3rd largest producer of rubber in the world. Kerala is the largest state for producing rubber in India. Numbers of employees are employed in rubber cultivations for their daily survival. But for their daily survival the workers risk their lives to work in the rubber plantations. There are many threats for the workers in the plantation areas since the rubber is cultivated in the areas where the temperature is 25°C-35°C. Mostly hilly areas are best suited for rubber cultivation. Along with rubber some of the other crops are also cropped which yields some more income for the plantation workers. The plants which are intercropped with the rubber attract animals which consume those crops. Since we are entering into the forest for our survival, the animals attack us for their survival which is common. But in this act the animals are killed by humans as a revenge for their attack. According to Comptroller and Auditor General of India report on Economic Sector, the total number of wild animal attacks on humans during the period of 2012-2015 is 166 including the 133 by elephants for the year 2015. For every consecutive year the number of such incidents has risen by the number of 5 - 15. The fault is not on the animal side since the rubber is cultivated in the areas where the animals live so the intrusion of the wild is unavoidable but the meeting of wild with the humans can be avoided. The most threatening animals in the plantation areas are Bear, Wild pig and Elephant. The elephant movement can be monitored by the humans but the other two

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animals cannot be monitored by the humans. So the primary task is to monitor the movement of those animals which are the main threat. Our project mainly focuses on the human safety and also ensuring the lives of the animals. The meeting of the humans with the wild is avoided to a greater extent. In the present days animal monitoring became very easier but in the same time the classification of animals is still a tedious process. In today's scenario animals are monitored using thermal imaging cameras and seismic data which become futile in hilly areas and forest areas where most of the land is covered by trees. The animal classification becomes the difficult task by this method. In this project the suggested system monitors the animals in a more elegant way and the classification of animals will become an easier task.

II. LITERATURE REVIEW

The existing systems for the detection and classification of animal mainly use Thermal imaging cameras, Image processing, Seismic data which are produced by the object in motion and PIR sensors.In the previously proposed systemsfor automatic animal detection used computer vision techniques [1]. It was proposed because to avoid collision of an animal with the vehicle on the highway which results in the death or injury of the animal or human beings due to the road accidents. Another system based on Image Processing incorporates various approaches for detecting the type of animal like Power Spectrum, Face detection and Threshold Segmentation for animal detection.[7]An algorithm is developed for the detection and identification of people and animals using acoustic, seismic and ultrasonic transducers.[9]A system called Large Animal Warning and Detection Systems (LAWDS) [5] which employs a 360° scanning radar to monitor the stretch of highways. The problem which is reported in LAWDS was vehicles and trees are wrongly identified as animals sometimes. So that 360° radar is incorporated here to detect the animals in the wide range of 1.5 km. false detection of birds, leaves and vehicles are avoided by this method. A system based on the seismic sensor and PIR sensor for target detection and classification which will be very much suitable for the real-time implementation of Unattended Ground Sensors [8]. The target's features are extracted from the seismic signals and PIR data signals using a symbolic dynamic filtering method and then the object is classified as Animal, Vehicle and Human etc..,.

III. PROPOSED SYSTEM

The proposed system mainly focuses on the safety of the human and also ensuring the security of the wild over human attacks on them. The system consists of sensors that are placed throughout the plantations in selected places where the animal activity is high and the areas where human work.The animal's presence is monitored in an elegant way using the PIR sensors and IR Temperature sensors. Then the data from the sensors are transmitted to the local base station where the data gets scrutinized and from here the intimation to the worker is sent so that the encounter of wild with human is avoided to a greater extent. Figure 1 shows the functional block of the system. By this system if any animal intrusion is detected in any of the area in the field the workers in that area as well as the workers who are near them are also getting intimation about the type of animal in their personal gadget so that they can help the worker who is in need of help.

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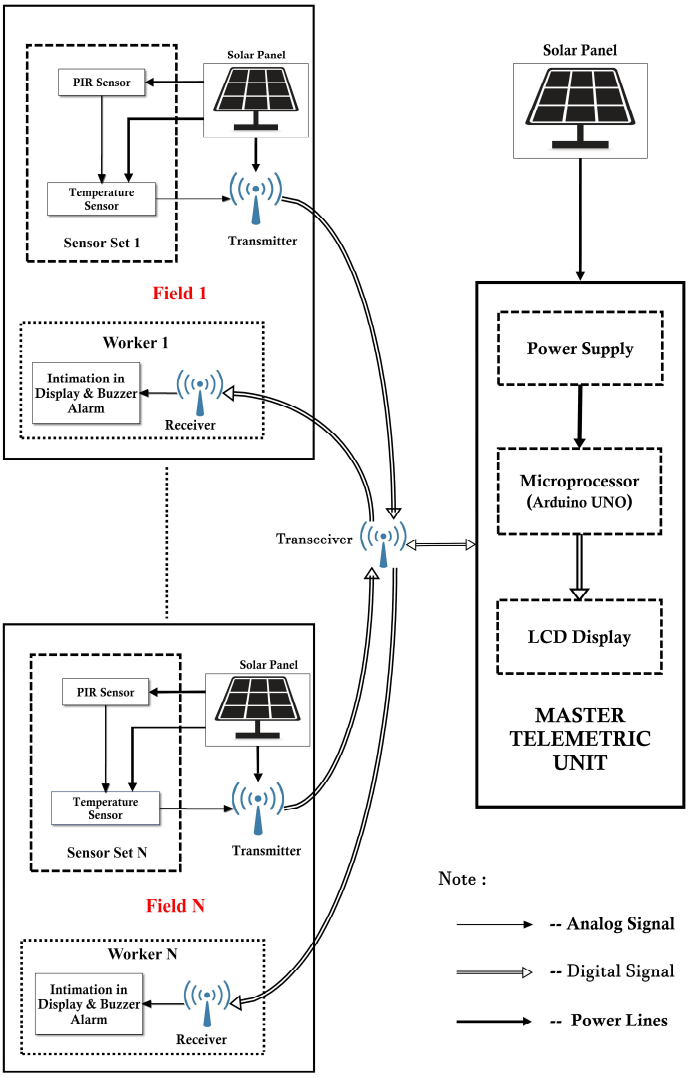

Figure 1. Block Diagram of Proposed System

IV. ARDUINO UNO REV 3

The Arduino Uno Rev 3 by Arduino is a cheap development microcontroller board for 25USD$. It consists of a 20MHz ATmega328P processor allows Uno Rev 3 to be small and developer friendly. It consists of 32 KB of In-System Self-Programmable Flash program Memory. It also has 1KBytes EEPROM and 2KBytes Internal SRAM. In general, it is powered by a 5-volt source like a USB port and in general, it has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analogue inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller.

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Figure 2. Arduino Rev 3 Microcontroller Board

V. PIC MICROCONTROLLER

The PIC controller compared to other controllers is with low cost. The clock speed of the controllers is high with the rate of 20MHz. 8Kx14 words of FLASH program memory, 368X8 bytes of data memory (RAM), 256x8 bytes of EEPROM data memory and this is enough for the temperature control application. At the maximum clock rate, a PIC executes most of its instructions in 0.2 micro seconds or 5 instructions per microseconds. It has high speed in executing instruction. The efficiency and accuracy is very high. The instruction set consists of 35 instructions.The PIC IC (Integrated Chip) is having wide operating voltage range from 2.5 to 6V, using power saving devices with a less power loss.

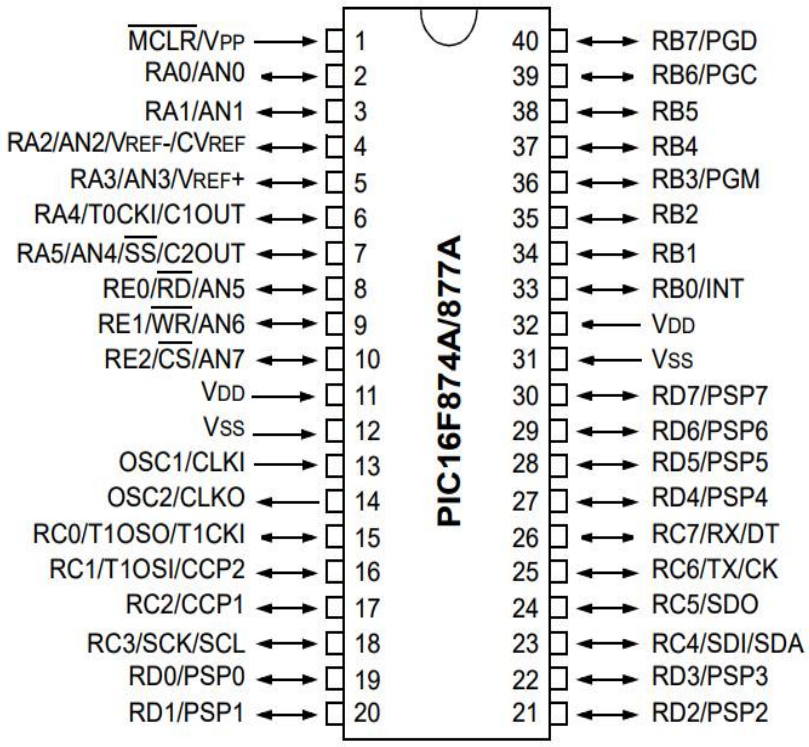

Figure 3. Pin Diagram of PIC16F877A

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VI. SYSTEM OPERATION

The proposed system mainly consists of 3 major sections:

1. Field Area;
2. Base Station;
3. Worker's Gadget.

1. Field Area

The field area primarily consists of PIR sensors and IR Temperature sensors placed in various locations of the field and are considered to be the main part in the field section. The animal's presence is monitored using the PIR sensor and if any object in motion crosses it within its range it gets detected by the sensor and then it sends a data to the microcontroller to which it is connected. Then the microcontroller sends the signal to the IR Temperature sensor and it starts to take the temperature samples of the object within its range. Figure 4. shows the block diagram of the field area and its components. This data is transferred to the microcontroller. The microcontroller sends the data to the Base Station through a wireless transmission. It uses a Zigbee RF Transceiver module to send and receive data. An Arduino Uno REV3 ATmega328P controller is used for this field section.

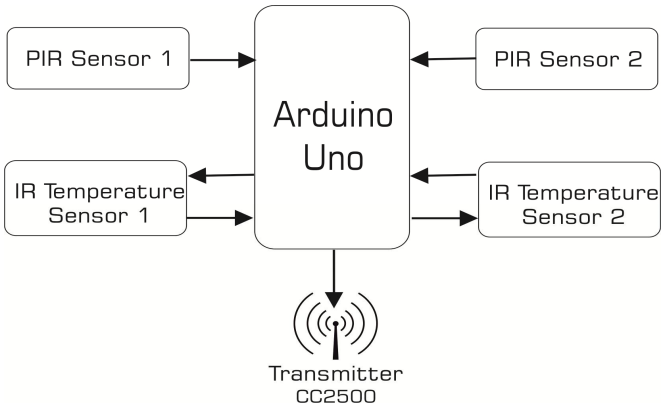

Figure 4. Blocks of Field Area

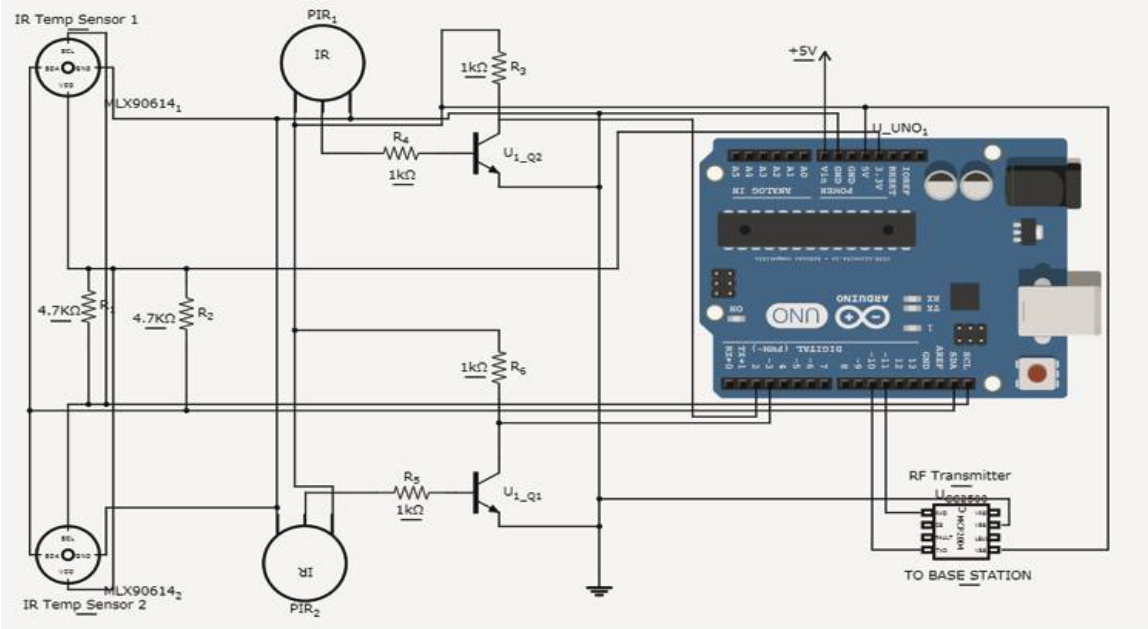

Figure 5. Circuit Diagram of Field Area

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The term PIR is the short form of the Passive Infra Red.PIR sensors have a 3-pin connection at the side or bottom. Figure 6shows the PIR sensor. One pin will be ground, another will be signal and the last pin will be power. Power is usually up to 5V and ranges between 3m to 7m at an angle of +15° or -15° but some of the bigger PIR sensor range is up to 10-20 meters at an angle of +90° or -90°. Interfacing PIR with microcontroller is very easy and simple. The PIR acts as a digital output so all you need to do is listening for the pin to flip high or low. The motion can be detected by checking for a high signal on a single I/O pin. Once the sensor warms up 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.

Figure 6. PIR Sensor

Infrared temperature sensors sense electromagnetic waves in the 700 nm to 14,000 nm range. While the infrared spectrum extends up to 1,000,000 nm, IR temperature sensors do not measure above 14,000 nm. These sensors work by focusing the infrared energy emitted by an object onto one or more photodetectors.Figure 7 shows the Infrared Temperature Sensor.

These photodetectors convert that energy into an electrical signal, which is proportional to the infrared energy emitted by the object. Because the emitted infrared energy of any object is proportional to its temperature, the electrical signal provides an accurate reading of the temperature of the object that it is pointed at. The infrared signals are passed into the sensor through a window made out of a specialty plastic. While plastic normally does not allow infrared frequencies to pass through it, the sensors use a form that is transparent to particular frequencies. This plastic filters out unwanted frequencies and protects the electronics inside the sensor from dust, dirt and other foreign objects.

Figure 7. Infrared Temperature Sensor

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2. Base Station

The base station has a processing unit which process the data received from the field area and here too a Zigbee RF transceiver module is used to receive and transmit the data. Figure 8 shows the connection between the Zigbee (transceiver) and the computer. The temperature samples which are received are scrutinized based on the preloaded values of different objects such as animals, human..., etc. Then if any sample value received is within the range of the preloaded value the respective object's name will be displayed in the computer and if any animal intrusion is detected then a message of warning is sent to the Worker and the intrusion data is recorded for future purpose.

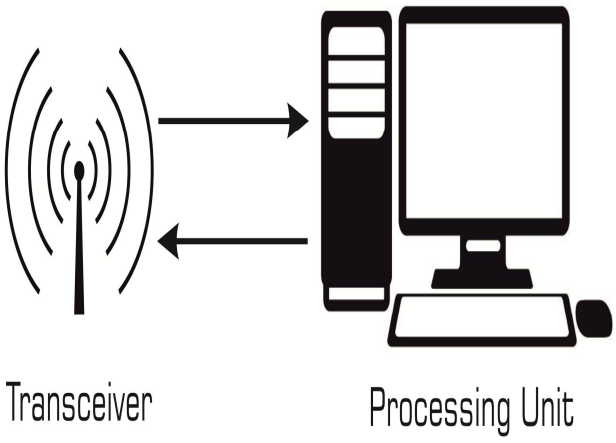

Figure 8. Blocks of Base Station

3. Worker Gadget

The worker has a gear which consists of an alarm and a display in which they get notified of animal's presence. The data which is received from the base station is displayed in the LCD Display and Buzzer is turned on for few seconds. It uses a PIC Microcontroller to receive and the process the data. The working components in worker's gadget are as shown in Figure 9.

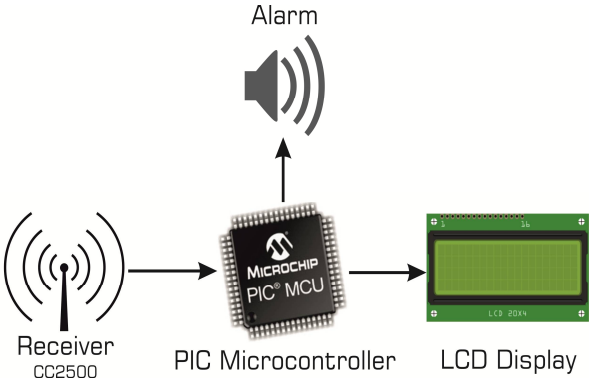

Figure 9. Block of Worker Gadget

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Figure 10. Circuit Diagram of Worker Gadget

VII. SIMULATION

The simulation is done using the Proteus software.Proteus PIC Bundle is the complete solution for developing, testing and virtually prototyping your embedded system designs based around the Microchip Technologies ™ series of microcontroller. It allows to perform schematic capture and to simulate the circuit design.

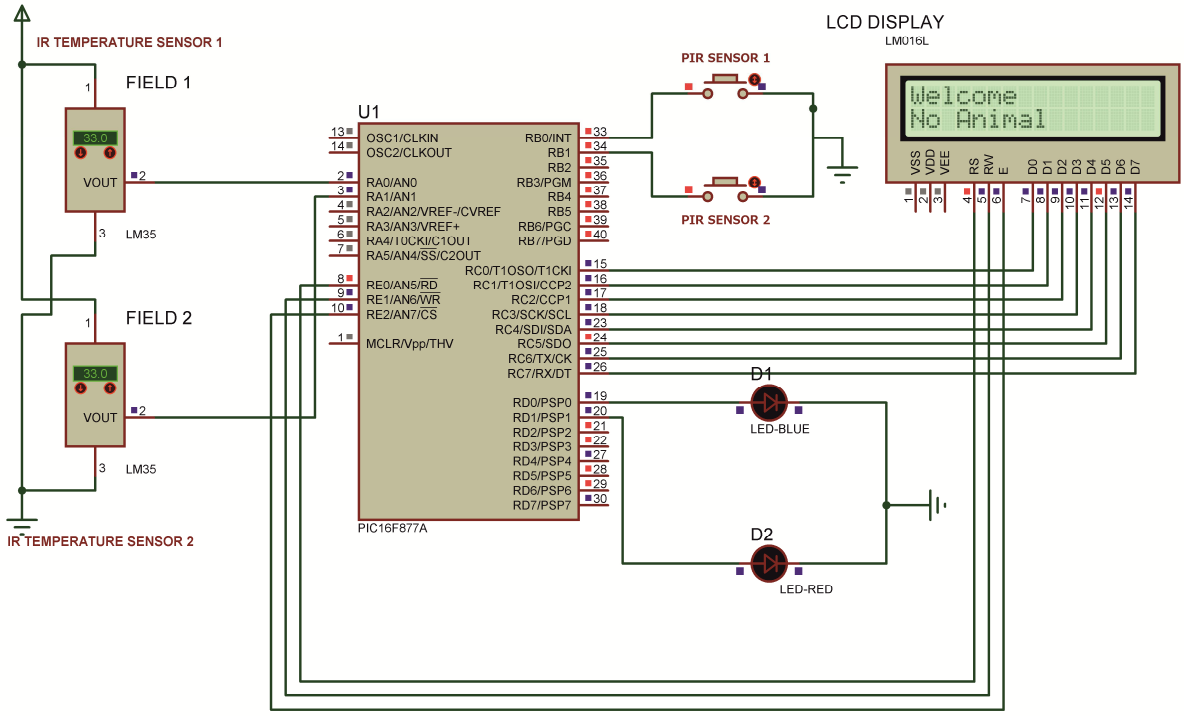

Figure 11. Simulation Circuit in Normal Condition

The above figure shows the Simulation circuit at normal conditions if any animal is detected in field 1 the PIR sensor gets activated but in the simulation circuit PIR sensor is replaced with a simple switch since PIR sensor is not available in the Proteus software and IR Temperature sensor is replaced with LM35 in the simulation circuit. Here a PIC microcontroller is used for simulation purpose.

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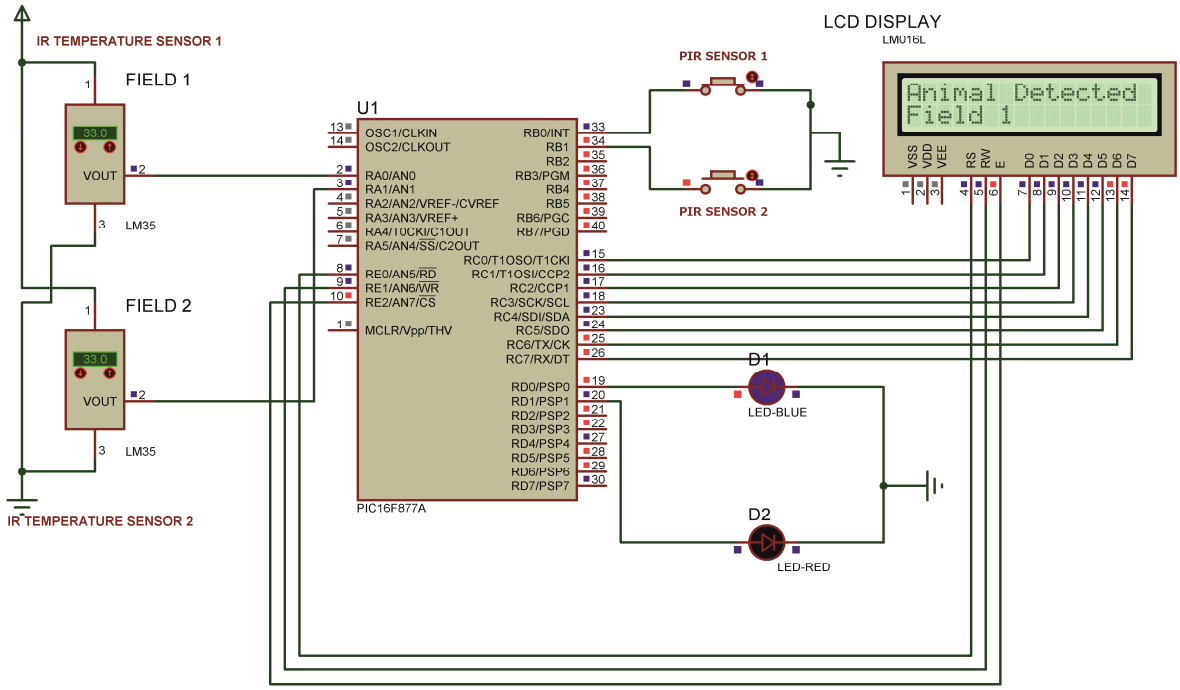

Figure 12. Animal Detected in Field 1

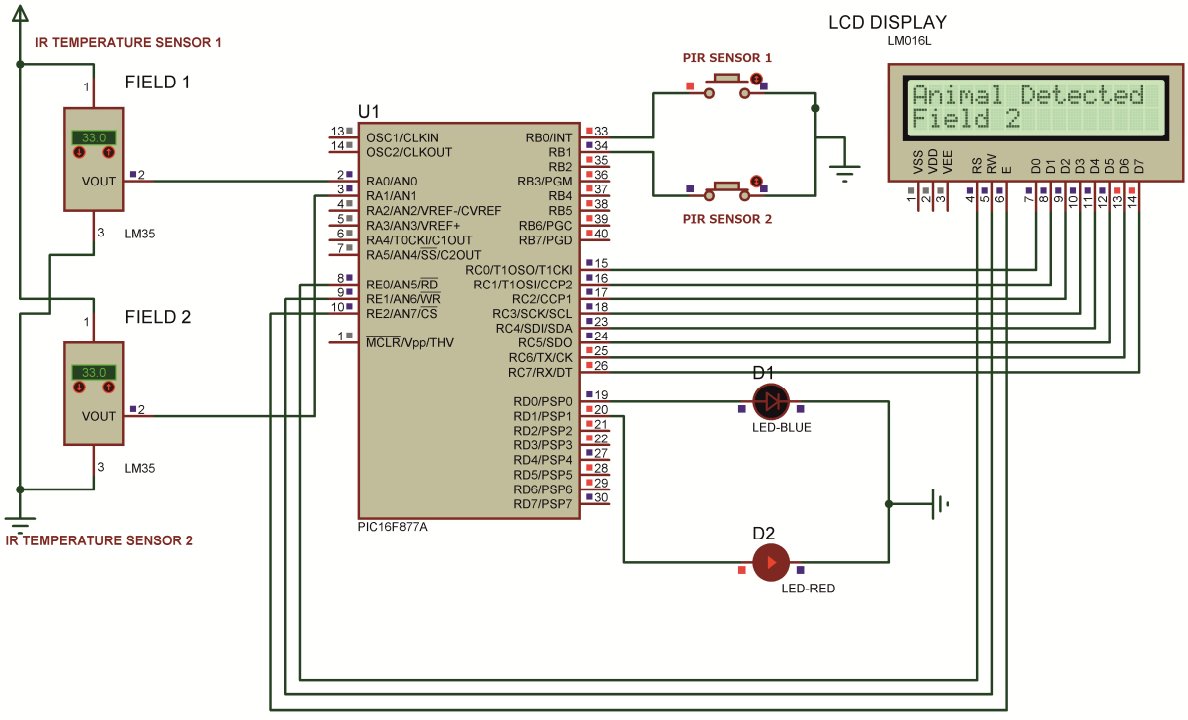

Figure 13. Animal Detected in Field 2

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Figure 12 shows the result of the simulation when the animal is detected in the field 1 by closing the PIR sensor the data from the Temperature sensor is transferred to the microcontroller and by scrutinizing the results with the predefined values the output result is displayed in the worker's gadget. Similarly in field 2 the output is checked and it is displayed in figure 13.The simulation circuit is checked by closing the switch but in real time PIR sensor activates of its own when any object motion is detected. Setting the temperature in the temperature sensor has to be done since we use LM35 as a sensor here we have to do it manually but in the real time IR Temperature sensor senses the temperature of its when clock pulses are sent to it.

VIII. CONCLUSION AND FUTURE SCOPE

The proposed system has an elegant way of monitoring the animal movement by placing the Passive Infrared sensor in various places across the field and the temperature samples are taken by using the Infrared Temperature sensor without touching it and harming the wild. The results of these sensors are scrutinized and the target is classified based upon the body temperature. If any animal intrusion is detected in the field an intimation is provided to the worker in the respective field so that the encounter of the wild with the human is avoided to a greater extent and also an intimation is provided to the workers in the nearby fields so that they can help the person who encounters with the wild. So by this the probability of saving the life of the human being gets increased as well as the security of the animal is also ensured. The reliability of the system is increased thereby decreasing the unwanted animal attacks. The proposed system mainly focuses on the areas where the Rubber Plantations are there and where limited amount of animals are the main threat. But it can also be implemented in various locations like Tea Estates and forest areas where human intrusion is high by simple modifications. Animals with same body temperature can be also possible in a same location this could be avoided by increasing the reliability by using cameras in it for classifying the animals. The system also provides scope automatic fire detection in case of forest fire.Thus the system proposed serves as a lifesaving equipment for human beings as well as the animals.

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