PIR based Energy Conservation by using Electrical Appliances

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Abstract— Intelligent Energy Saving System can be used in places like where lighting is very important. The libraries will be well illuminated with many lamps. When people are not present at a reading place the lighting can be made OFF and when they are present, the lighting made ON. All these can be done through by Dimming circuit and PIR sensor. If a person entering to the monitored area, the PIR sensors activates and sense the person, gives to the micro controller. The Infrared energy emitted from the living body is focused by a Fresnel lens segment. Then only the PIR sensor activates. After sensing the person LDR checks the light intensity of the monitored area, whether it is bright or dark. Depending on the LDR output, the lamp may be ON / OFF by using Dimmer circuit. By using this system we can adjust the speed of Fan according to the room temperature measured by Thermostat, which is connected to the micro controller. To display the room temperature of PIR mode operation we are using the LCD display.

Key words: PIR, Energy Conservation, Electrical Appliances

I. INTRODUCTION

Passive infrared (PIR) sensors are widely used as a presence trigger, but the analog output of PIR sensors depends on several other aspects, including the distance of the body from the PIR sensor, the direction and speed of movement, the body shape and gait. In this paper, we present an empirical study of human movement detection and identification using a set of PIR sensors. We have developed a data collection module having two pairs of PIR sensors orthogonally aligned and modified Fresnel lenses.

We have placed three PIR-based modules in a hallway for monitoring people; one module on the ceiling; two modules on opposite walls facing each other. We have collected a data set from eight subjects when walking in three different conditions: two directions (back and forth), three distance intervals (close to one wall sensor, in the middle, close to the other wall sensor) and three speed levels (slow, moderate, fast). We have used two types of feature sets: a raw data set and a reduced feature set composed of amplitude and time to peaks; and passage duration extracted from each PIR sensor.

We have performed classification analysis with well-known machine learning algorithms, including instance-based learning and support vector machine. Our findings show that with the raw data set captured from a single PIR sensor of each of the three modules, we could achieve more than 92% accuracy in classifying the direction and speed of movement, the distance interval and identifying subjects. We could also achieve more than 94% accuracy in classifying the direction, speed and distance and identifying subjects using the reduced feature set extracted from two pairs of PIR sensors of each of the three modules. With the advancement of sensor and actuator technologies, our indoor environment, such as buildings, has been instrumented with various sensors, including temperature, humidity, illumination, CO2 and occupancy sensor, and, thus, can be aware of changes in the user's state and surrounding, finally controlling building utilities to adapt their services and resources to the user's context, e.g., automatic lighting control, heating, ventilation and air-conditioning (HVAC) system adjustment, electrical outlet turn-off, unusual behavior detection and home invasion prevention.

Such context-aware systems have deployed occupant location as the principal form of the user's context. Accordingly, indoor tracking and localization is one of the key technologies for providing activity-aware services in a smart environment passive infrared (PIR) sensors are well-known occupancy detectors.

They have been widely employed for human tracking system, due to their low cost and power consumption, small form factor and unobtrusive and privacy-preserving interaction. In particular, a dense array of PIR sensors having digital output and the modulated visibility of Fresnel lenses can provide capabilities for tracking human motion, identifying walking subject and counting people entering or leaving the entrance of a room or building. However, the analog output signal of PIR sensors involves more aspects beyond simple people presence, including the distance of the body from the PIR sensor, the velocity of the movement (i.e. Direction and speed), body shape and gait (i.e., a particular way or manner of walking).

Thus, we can leverage discriminative features of the analog output signal of PIR sensors in order to develop various applications for indoor human tracking and localization. In this paper, we present an empirical study of human movement detection and identification using PIR-based modules having two pairs of orthogonally-aligned PIR sensors. We have developed a data collection module consisting of two pairs of PIR sensors whose dual sensing elements are orthogonally aligned and Fresnel lenses are modified to narrow the field of view of the PIR sensors to its horizontal motion plane, a data logger, op-amp circuits and a rechargeable battery.

We have placed three PIR-based modules in a hallway for monitoring people; one PIR-based module is placed on the ceiling; two PIR-based modules are placed on opposite walls facing each other. We have collected a data set from eight experimental subjects when walking in three different conditions: two directions (back and forth), three distance intervals (close to one wall sensor, in the middle, close to the other wall sensor) and three speed levels (slow, moderate, fast). We have employed two types of feature sets: a raw data set and reduced feature set composed of amplitude and time to peaks; and passage duration extracted from each PIR sensor.

We have performed classification analysis according to various configurations, including the number of modules involved (ceiling-mounted module vs. wall-

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mounted modules), the number of PIR sensors involved (a single PIR sensor, a pair of PIR sensors orthogonally aligned and two pairs of PIR sensors orthogonally aligned), the feature set (raw data set vs. reduced feature set) and well-known machine learning algorithms, including instance-based learning and support vector machine. Our findings show that with the raw data set captured from a single PIR sensor of each of the three modules, we were able to achieve more than 92% correct detection of direction and speed of movement, the distance interval and identification of walking subjects.

We could also achieve more than 94% accuracy in classifying the direction, speed level and distance interval and identifying walking subjects using the reduced feature set extracted from each of the three modules equipped with two pairs of PIR sensors. The rest of the paper is organized as follows introduces various indoor localization and tracking and motion detecting systems using PIR sensors. Presents a human movement detection and identification system and explains what aspects of PIR sensors we employ to detect the direction and speed of movement and the distance interval. Section 4 describes the PIR sensor-based movement detecting device and data collection procedure and explains which features we extract from the raw data set and which classifiers we employ for machine learning. presents the experimental results of the classification analysis with the raw data set and reduced feature set extracted

II. MATERIAL

A. *Passive Infrared Sensor (PIR Sensor)*

A passive infrared sensor (PIR sensor) is a sensor to measures infrared rays (IR) light radiating from moving body of object. PIR sensor sense the heat of the object i.e. human body.

B. *LDR (Light Dependent Resistance)*

It stands for Light Dependent Resistor or Photo resistor, which is a passive electronic component, basically a resistor which has a resistance that varies depending of the light intensity. A photo resistor is made of a high resistance semiconductor that absorbs photons. It also based on the frequency of the photons. The total number of electrons is dependent of the photons frequency.

1) *Description of LDR*

The LDR resistance is increases as darkness is increases, almost high as 1MΩ but when there is light rays that incident on the LDR, the resistance is decreasing to a few KΩ (10-20kΩ @ 10 lux, 2-4kOmega; @ 100 lux) depending on the model LDRs are very useful in many electronic circuits, especially in digital devices and more other. There are some audio application and sound system. It is used for turn ON or OFF a device according to the ambient light. On electroschematics.com we have some circuits that uses the photo resistor.

C. *Relay*

A relay is an electrically operated switch. A relay use an electromagnet to operate a switch mechanically, some other operating principles are also used, such as solid-state relays. Relays are used for controlling a circuit by a low power signal. The relay is used in long distance telegraph circuits as amplifiers they repeated the signal come from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and nowadays it use to perform logical operations in computers.

D. *Temperature Sensor*

The temperature sensor device is that they are used for specially designed to measure the heat of an object. However, sensors are actually measuring the change in temperature. When temperature sensor devices read an object with zero change in temperature, that point takes as an initial temperature. When a substance is heated, it usually moves through some phases solid to liquid and from liquid to gas until also change in temperature increasing or decreasing.

III. BLOCK DIAGRAM

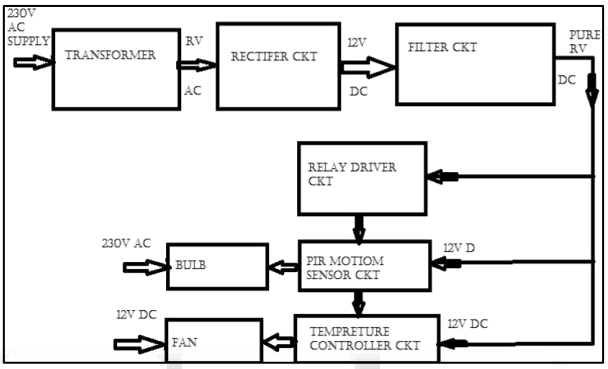

Fig. 3.1: Block Diagram of Proposed System

A. *Passive Infrared Sensor (PIR)*

A PIR detector is a motion detector that senses the heat emitted by a living body. These are often fitted to security lights so that they will switch on automatically if approached. They are very effective in enhancing home security systems. The sensor is passive because, instead of emitting a beam of light or microwave energy that must be interrupted by a passing person in order to sensel that person, the PIR is simply sensitive to the infrared energy emitted by every living thing. When an intruder walks into the detector‘s field of vision.

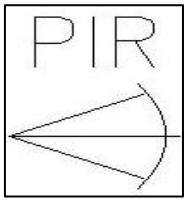

Fig. 3.2: PIR Sensor

B. *How PIRs Work*

PIR sensors are more complicated than many of the other sensors explained in these tutorials (like photocells, FSRs and tilt switches) because there are multiple variables that affect the sensors input and output. To begin explaining how a basic sensor works, we'll use this rather nice diagram The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors.

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When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected. This image shows the internal schematic. There is actually a JFET inside (a type of transistor) which is very low-noise and buffers the extremely high impedance of the sensors into something a low-cost chip (like the BIS0001) can sense.

IV. RESULT

A. Human Detection

Human detection part of the project entirely depended on the program responsible for the subtraction of any background noises. The PIR sensor responsible for the detection of motion adjusts itself to the infrared signature of its surroundings and keeps watching for any changes. In the absence of motion, the LED indicator will remain dim, and the program will continue updating the surroundings. If the sensor detects movement, the frame for motion detected will be the input frame to the process of human detection, and consequently, the motion detection indicator will light up.

B. Image Capture & Video Recording

Upon confirmation of intrusion of a human in the field of view of the sensor, the Passive Infrared sensor triggers the pi camera through the Raspberry pi. RPI directs instructions to the pi camera to click the picture and consequently save it. While capturing the image of the intruder, the pi camera records video of the occurrence and keeps it with a name containing the date and time of entry. Below in figure A is a captured image by the surveillance.

V. CONCLUSION

Intelligent Energy Saving System is not limited for any particular application, it can be used any wherein a process industries with little modifications in software coding according to the requirements. This concept not only ensures that our work will be usable in the future but also provides the flexibility to adapt and extend, as needs change.

In this project work we have studied and implemented a complete working model using a PIC microcontroller. The programming and interfering of motion sensor has been mastered during the implementation. This work includes the study of energy saving system in many applications.

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