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Research Article

IOT-BASED OCCUPANCY MONITORING TECHNIQUES FOR ENERGY EFFICIENT SMART BUILDINGS

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ABSTRACT

Energy efficiency has become a necessity to reduce the overall energy consumption, where a lot of energy consumption can cause greenhouse gas emissions and other pollutants. To overcome this problem energy saving strategies can be carried with the help of occupancy changes. In this research IoT based occupancy monitoring system is proposed to control the electrical devices, which is done by detecting an occupant with the help of a RFID tag which is dedicated to the occupant with their respected needs. Here occupancy monitoring is for a private space or if a private cabin is allotted for a person. This leads to the reduction of energy by less usage of the electricals which leads to energy efficiency by the occupant. The framework is intended to detect the occupancy of a chosen region, for this we require sensors for example temperature sensor and light sensor. All the sensors information is gathered by a microprocessor and then this information is uploaded through IoT, where the needs of an occupant are monitored. Monitoring is required for paying close attention. It is a type of systematic observation of one's activities. There were many researches before, where a sensor-based network was used for occupancy monitoring or a camera-based network. Which caused issues of accuracy and cost. Usage of camera-based network led to a privacy breach. So, to overcome this problem IoT based occupancy has come into light.

I. INTRODUCTION

Occupancy detection of a space is challenging these spaces can be monitored for energy efficiency. This leads to smarter buildings with spaces according to one's needs and less energy wastage. These smart buildings are achieved with the help of Internet of Things (IoT). The space can be managed by various components which can interact with the IoT devices. With the availability of IoTs in commercial or private space, building occupants and environment can be

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monitored in real time. In this way, we can save a lot of energy by reducing the usage of components which are not needed and environment can be set by the needs of a person. Energy efficiency is based on the person who is occupying the area. Each area is divided with the entry point with RFID and with this the devices are controlled when a person enters the location, also the advantage is that here manual switching can be avoided. IoT provides us the data which is being monitored with the help of RFID tags for the project management team to keep a track of all the devices. So, in future any changes in the requirements are required can be changed based on this data. This system also provides full privacy as this system does not contain any camera-based network, with which there cannot be any invasion in privacy.

II.EXISTING MODEL

The existing model focuses more on only using camera-based monitoring. The existing model also uses low range IR sensors for counting people which works for limited distance coverage and controlling which implements the controlling of the home appliances with efficient power saving. These sensors emit an infrared ray and checks in the return signal, which only works for limited distance coverage. These infrared frequencies are affected by hard objects like walls, doors, smoke, dust, fog, and sunlight etc., Hence it does not work through walls or doors. The existing model doesn't show a clear picture about the components used which made the research complicated and difficult to understand. The existing model focuses more on the usage of camera-based monitoring.

III. DESCRIPTION OF PROPOSED MODEL

The proposed model is to overcome the problems of the previous research. RFID technology is used in this project. It increases the usage RFID technology to provide essential security to our homes and for other control applications. Capable of motion & disturbance detection at entry points along with security alarm system having alerts containing picture, was implemented to allow real time monitoring of the building anywhere and anytime. The circuit is simplified using a microprocessor which leads to a less complicated circuit. The processes can be displayed on an application for convenience of the users. The Raspberry Pi board has a processor and a camera chip, as well as RAM and a variety of ports and connections for external devices. Some of these instruments are required, while others are not It functions in the same way as a standard computer, requiring a keyboard for command entry, a display unit, and a power supply. Because the Raspberry Pi board functions like a computer, it necessitates mass storage, but a hard disc pressure comparable to that found in a standard computer is not in keeping with the Raspberry Pi's small size.

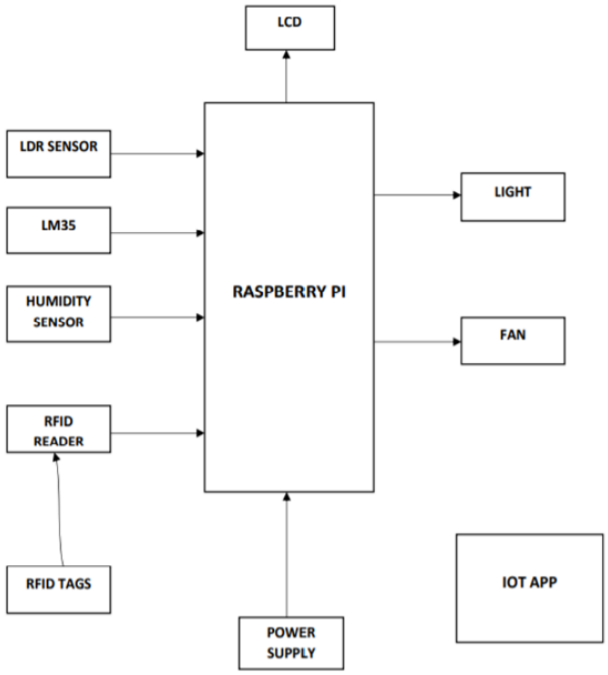

Fig 1: Block diagram of proposed model

Here we use a microprocessor, which is the Raspberry Pi 3. Sensors are connected to the microprocessor where the sensors like light sensor, temperature sensor and humidity sensors senses the environment around them and gives the input to the microprocessor. RFID tags are used to which the outputs are given to the RFID reader.

What does the RFID reader and tags used for? An RFID reader is a device that is used to interrogate an RFID tag. The reader has an antenna that emits radio waves; the tag responds by sending back its data. An RFID tag is a microchip combined with an antenna in a compact package; the packaging is structured to allow the RFID tag to be attached to an object to be tracked. A power supply is given to the microprocessor. Any indications can be displayed with the help of a 16x2 LCD display. The microprocessor output is given to electronic devices like light or fan or HVAC appliances can work too. Where the devices can work as we desire them to. This project consists of a microprocessor, a 16x2 LCD display, LM358, MCP3209, RFID Scanner, RFID tags, fan and light. The sensors used are LDR sensor, Temp sensor, Humidity sensor.

The sensors used are LDR sensor, Temp sensor, Humidity sensor. The sensors outputs are passed through the LM358 which are the amplifiers, it can also be used as can be used as transducer amplifier, DC gain block etc. It has large dc voltage gain of 100dB. This IC can be operated on wide range of power supply from 3V to 32V for single power supply or from ±1.5V to ±16V for dual power supply and it also support large output voltage swing.

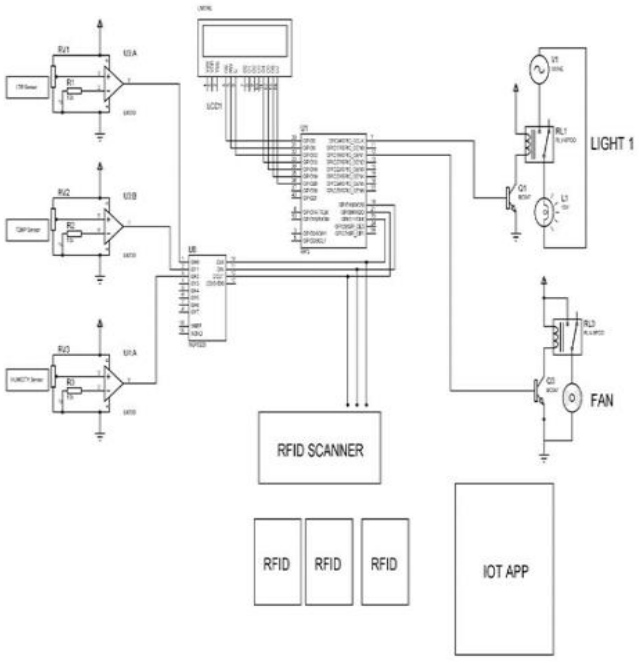

Fig 2: Schematic diagram of the proposed system

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The output of the amplifiers is given to the MCP3209 which is an analog to digital converter because the Raspberry Pi 3 input takes only digital inputs, whereas the sensor outputs are in the form of analog. The LCD is connected to the microprocessor for displaying the output. RFID Scanners are connected with the outputs of the MCP3209 and given to the GPIO pins of the Raspberry Pi 3. The program is fed to the microprocessor and according to that program functioning of the light and fan takes place.

IV. HARDWARE DESCRIPTION

The Raspberry Pi 3's four built-in USB ports are plenty for connecting a mouse, keyboard, or anything else the RPi requires, but if you need more, a USB hub can be used. Keep in mind that you should use a powered hub to avoid overloading the on-board voltage regulator. Simply insert any USB power supply into the Raspberry Pi 3's micro-USB port to power it. Because there is no power button, the Pi will start to boot as soon as power is provided; to turn it off, simply unplug it. A passive tag is one that doesn't have a battery and is powered solely by the scanner. The coiled antenna within a passive rfid tag creates a magnetic field when it comes into contact with radio waves from the reader. The tag uses it to get electricity, which powers the tag's circuits. The data stored in the tag's memory is then transmitted.

Fig 3: Raspberry Pi

A passive tag is one that does not have a battery and relies on the scanner for power. When a passive rfid tag encounters radio waves from the reader, the coiled antenna within the tag creates a magnetic field. The tag draws electricity from it, which powers the tag's circuits.

Fig 4: RFID scanner and tags

The information contained in the tag's memory is then sent. In this research we use three types of sensors like humidity sensor which is an instrument used for measuring the moisture content in the environment. Humidity measurement tools typically rely on other measures such as temperature, pressure, mass, or a mechanical or electrical change in a substance as moisture is absorbed. These measurable quantities can be used to calculate humidity using calibration and calculation. An LM35 sensor is used which are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. A power supply is the most important part of any circuit. The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.

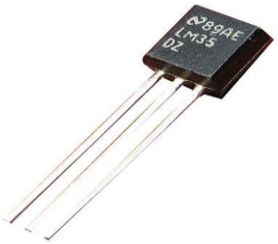

Fig 5: LM35

The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A full-wave rectified voltage is then provided by a diode rectifier, which is first filtered by a simple capacitor filter to produce a dc voltage. There is frequently some ripple or ac voltage change in the resulting dc voltage. Even if the input dc voltage varies or the load attached to the output dc voltage fluctuates, a regulator circuit removes

the ripples and maintains the same dc value. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

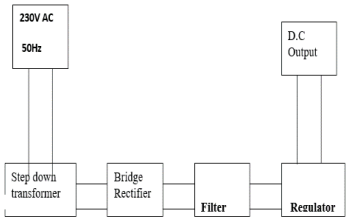

Fig 6: block diagram of power supply

V. SOFTWARE DESCRIPTION

To successfully complete the task of Hardware implementation, a working software is needed. Why is a software needed? Software, unlike hardware, can do a wide range of jobs. Hardware, on the other hand, can only execute the mechanical functions for which it was created. Software allows you to perform a wide range of jobs with the same fundamental hardware. The Raspberry Pi is a single-board computer developed by the Raspberry Pi Foundation, a UK-based charity organization. Originally designed to provide young people with an affordable computing option to learn how to program, it has developed a massive following in the maker and DIY communities because of its compact size, full Linux environment, and general-purpose input–output (GPIO) pins. Python is a dynamically semantic, interpreted, object-oriented high-level programming language. Its high-level built-in data structures, together with dynamic typing and dynamic binding, making it ideal for Rapid Application Development and as a scripting or glue language for connecting existing components. Python's concise, easy-to-learn syntax prioritizes readability, which lowers software maintenance costs. Modules and packages are supported by Python, which fosters programmer modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

Fig 7: Python software

With the help of Blynk app, which is an IoT application, we creating a sever with which the occupancy is being monitored. The application is connected to the Raspberry Pi, then the monitoring is done according to the python code. Blynk is a Platform with IOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets.

Fig 8: Blynk app

VI. RESULTS

The hardware is connected as per the circuit diagram and the software is fed to the Raspberry Pi with the code which was designed for this project. The code is made to run on the Raspberry Pi with which the kit works according to the code.

Fig 9: connection established

The connection is established and is being asked to scan the cards which has already been structured according to a person's needs.

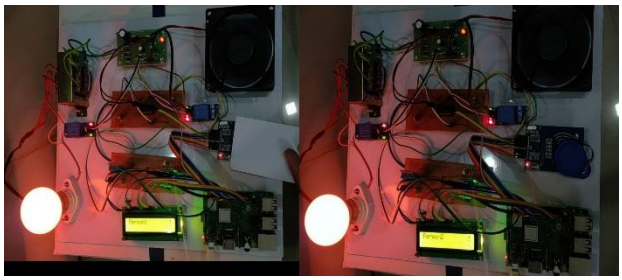

Fig 10: Tags are being scanned

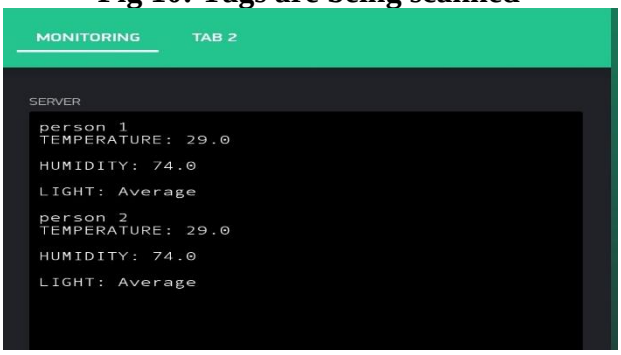

Fig 11: Monitoring of occupancy

The project has been successfully been tested. It has been developed with the integration of hardware components and software.

VI. CONCLUSION

In this project work, we have studied and implemented a complete working model using a Microprocessor. The programming and interfacing of microprocessor has been mastered during the implementation. This work includes the study of the IoT based occupancy monitoring techniques for energy efficient smart buildings. The microprocessor is used for controlling the appliances for saving energy. LCD would display the corresponding results. In a nutshell, the project is based on sensors and RFID tags and scanner. This results in controlled devices and energy efficient buildings.

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