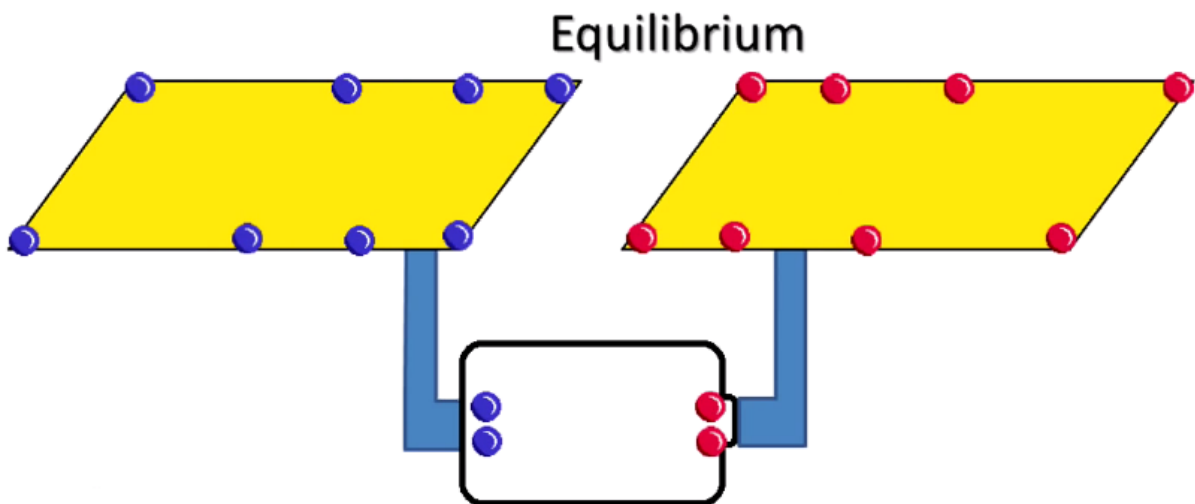


INTRODUCTION

Conventional home monitoring and automation systems use CCTV cameras and all this is monitored on a Personal Computer that takes in a monstrous power consumption of 80 to 250 watts. Home automation is rarely seen due to its immense expense. On the other hand, we lose ample amount of electricity many a times due to human ignorance. So we propose a hybrid concept integrating a simple principle of “Capacitive touch sensing” using metal foils along with AVR and several other concepts to make a cheap, efficient and safe Monitoring and Automation System.

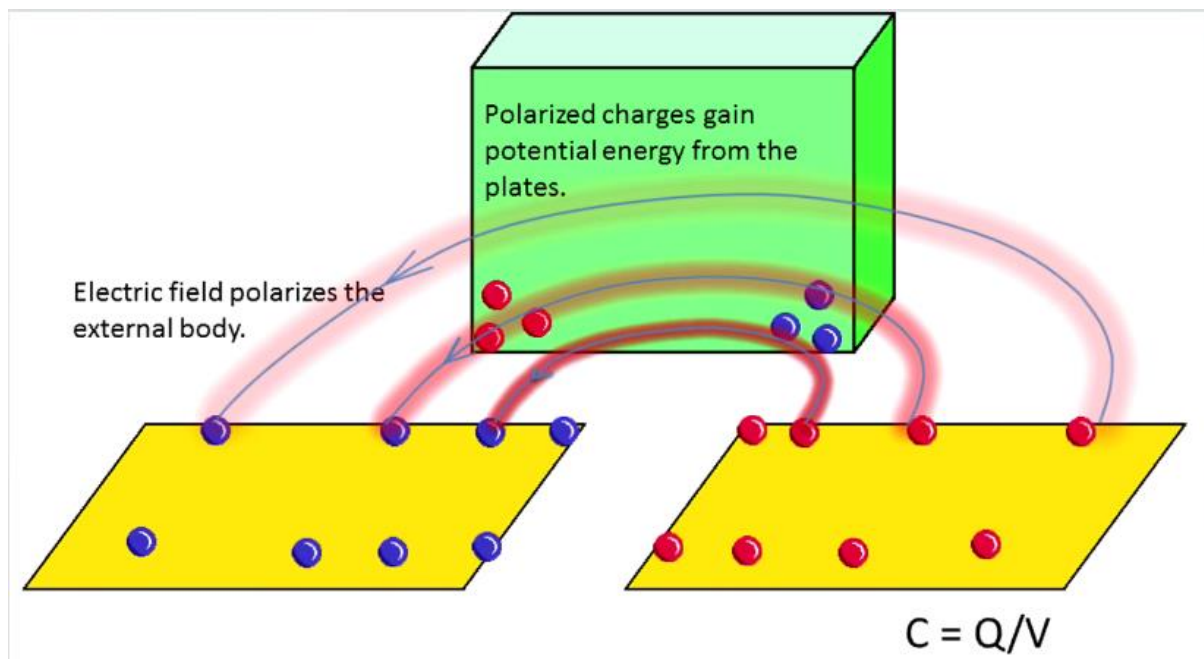
THEORY



When conductors are connected to the source, the electric field from the source pushes the charges out to the conductors. The positive and negative charges present on the plates are repulsive to each other. So they repel each other and evenly distribute on the surface of the conductor. As more and more charges join in, they build up electric field to oppose other charges from joining in. Eventually the net force is zero and the charges stay in equilibrium. This happens when the plates have the same potential difference as the voltage source.

When an external conductor is put nearby, it cuts through the electric field. The field polarises the conductor and energy is transferred to the object.

This reduces the potential energy of plates and now more amount of charges join in to compensate for the lost potential.



$$C = Q/V$$

More charges flow from voltage source to the plates.

Capacitance increased

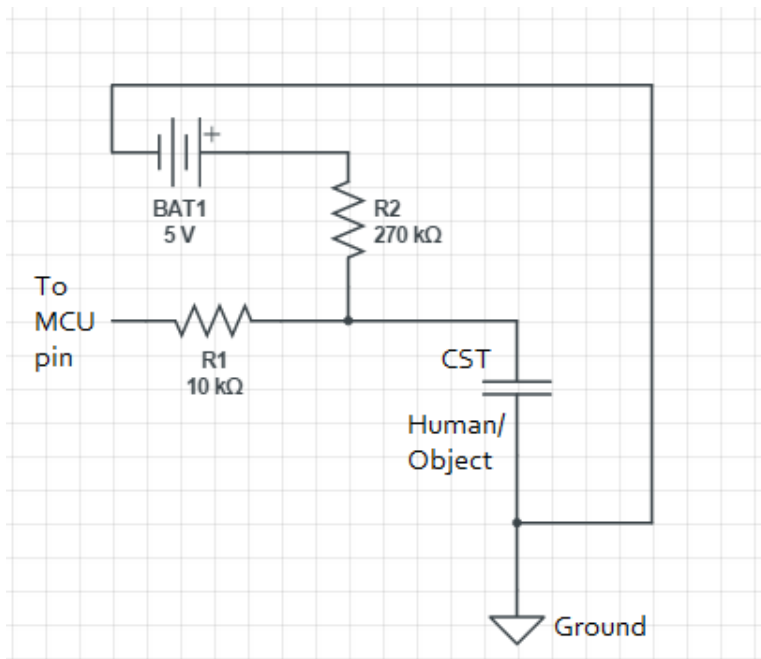
In capacitive sensing a plate is constantly charged and discharged by the microcontroller.

As the capacitance is finite the time constant which is the time taken to fully charge the capacitor plate remains the same.

As soon as an external conductor approaches, the capacitance changes as explained above and hence the time constant.

This change in time constant is measured by the microcontroller and hence human presence is detected.

PROJECT DESCRIPTION



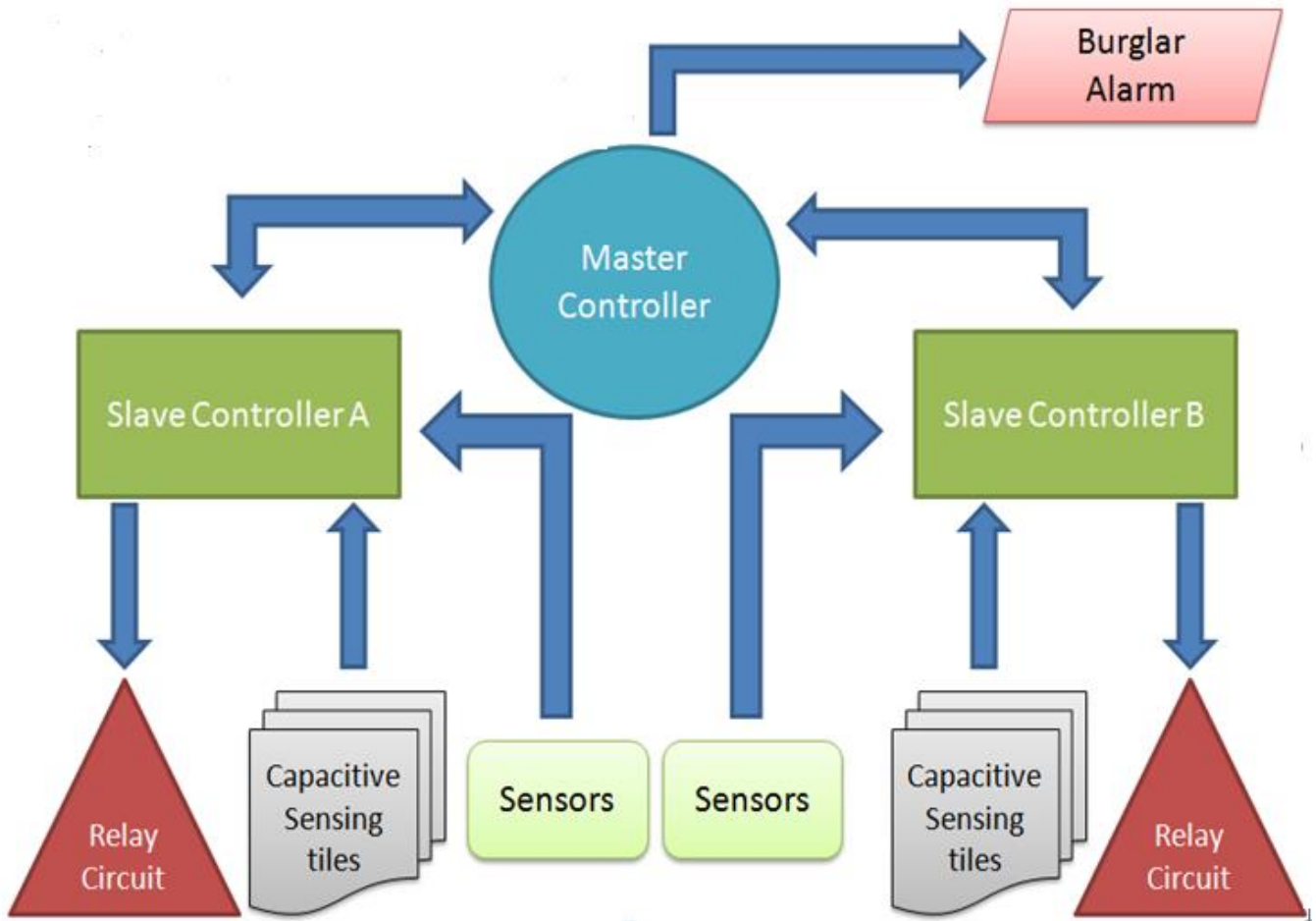
R1 is the charging resistor and R2 is the discharging resistor for the plates.

The Capacitive Sensing Tiles (CSTs) will cover the complete floor space of a house. The CST, used for sensing objects,

must be insulated from each other as well as the ground. A wire from each tile would go to the Slave (detecting) microcontroller. The slave microcontroller would be able to accommodate the max number of tiles based on availability of input pins on microcontroller. Each slave microcontroller will detect the variation of capacitance in CSTs and send the positions to the Master controller accordingly. Master controller stores the data like the current modes and the threshold values etc. Slave controllers for each room control home automation based on the temperature, light intensity, data on master controller and human presence and triggers relay circuits installed in switchboards accordingly. The Master Controller can also track the movements of people around the house.

A burglar alarm can be triggered by Master Controller in case of burglary when during Watchdog Mode.

For the prototype, we have used a large piece of wood acting as a pseudo floor with the Capacitive sensing tiles installed on them with good insulation and precision. A series of lamps and fans will resemble home appliances.



- **Component description**

Capacitive sensing tiles: A square sheet of metal foil will be used as a sensor tile to pick up position of any human within the walls of the house. These tiles are insulated from both top and bottom by using plastics. They are placed on the floor of the house at fixed distance from one another forming an electrical coordinate system on the floor. They are supplied voltage from A.C. mains using step-down adapters that provide a 5 volt DC supply or from a 12-volt DC power supply backup battery in case of power cuts; along with pull-up resistors for noise reduction. The home monitoring/tracking sensor grid can be installed completely using just metal foils. Dimensions of the tiles are set in the

range of 1-2 feet and are calibrated to pick up objects within a sphere of approximately 1-2 feet diameter.

Slave Controllers: Slave Controllers take inputs from capacitive sensing tiles and use 8-bit or 16-bit Timer Counter to determine the time constant for each capacitive sensing tile by observing PIN status on each port. Each room or hallway will require minimum of one Slave Controller or more depending on the size of room. This will also control the automation of home appliances for their respective rooms/area based on the sensor readings provided with them. The controller shall be fast processing to simultaneously detect large number of tiles and update the master controller in real time.

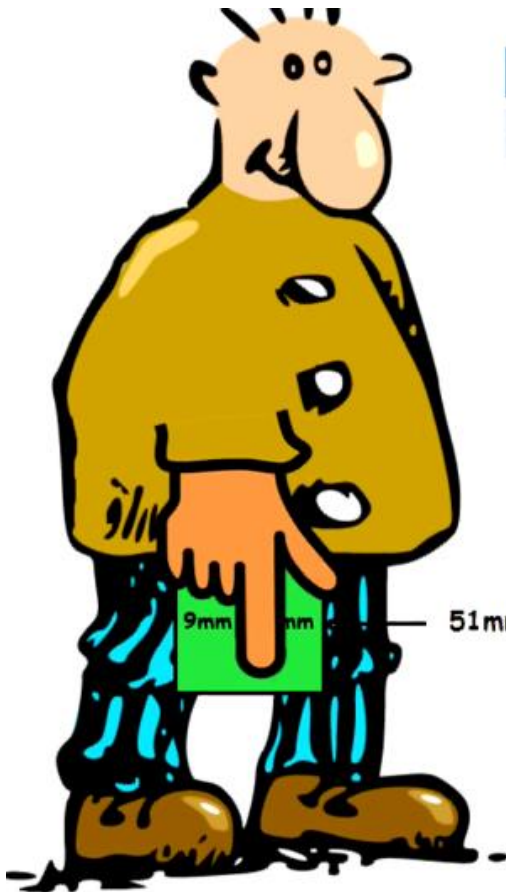
The Master Controller: The Master Controller is fed data from slave controllers, which processes it to display the position of the tile where the signal was picked up by Slave Controllers. It will be used to store required data and act as server for the whole system. It will also calculate certain statistics such as electrical units consumed in the month etc. It will also be used to track the movement of objects/people around the house and thus can be used to keep an eye on something/someone.

Relay, LDR & LM35 : Relays are used to switch on the main appliances running at 50 Hz 220 v.

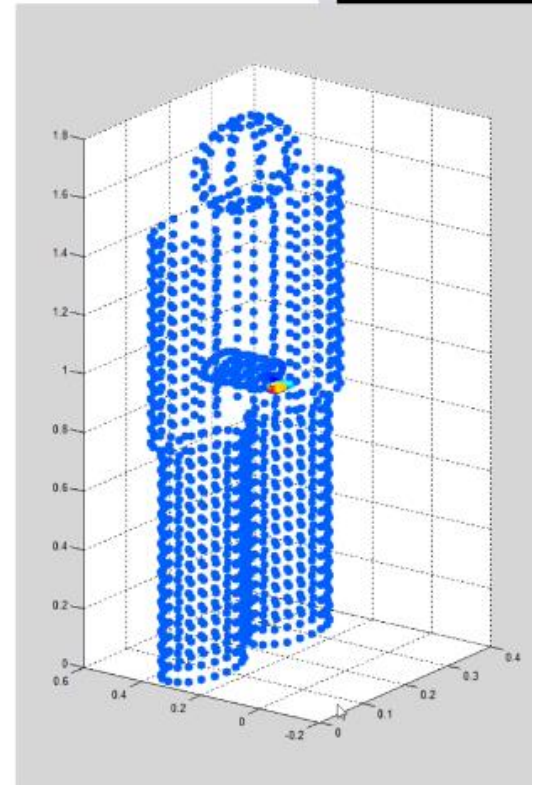
Light dependant resistors are used for detecting ambient light inside a room.

LM35 is a temperature sensing IC which gives analog values to the slave microcontroller.

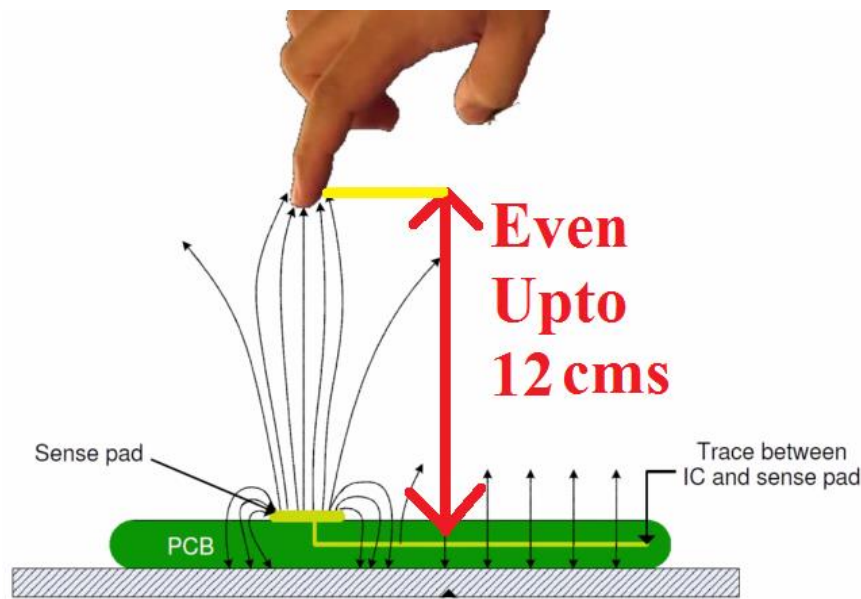
RESULTS



Before	After	ΔC	% change
0.189pF	0.245pF	0.056pF	30%

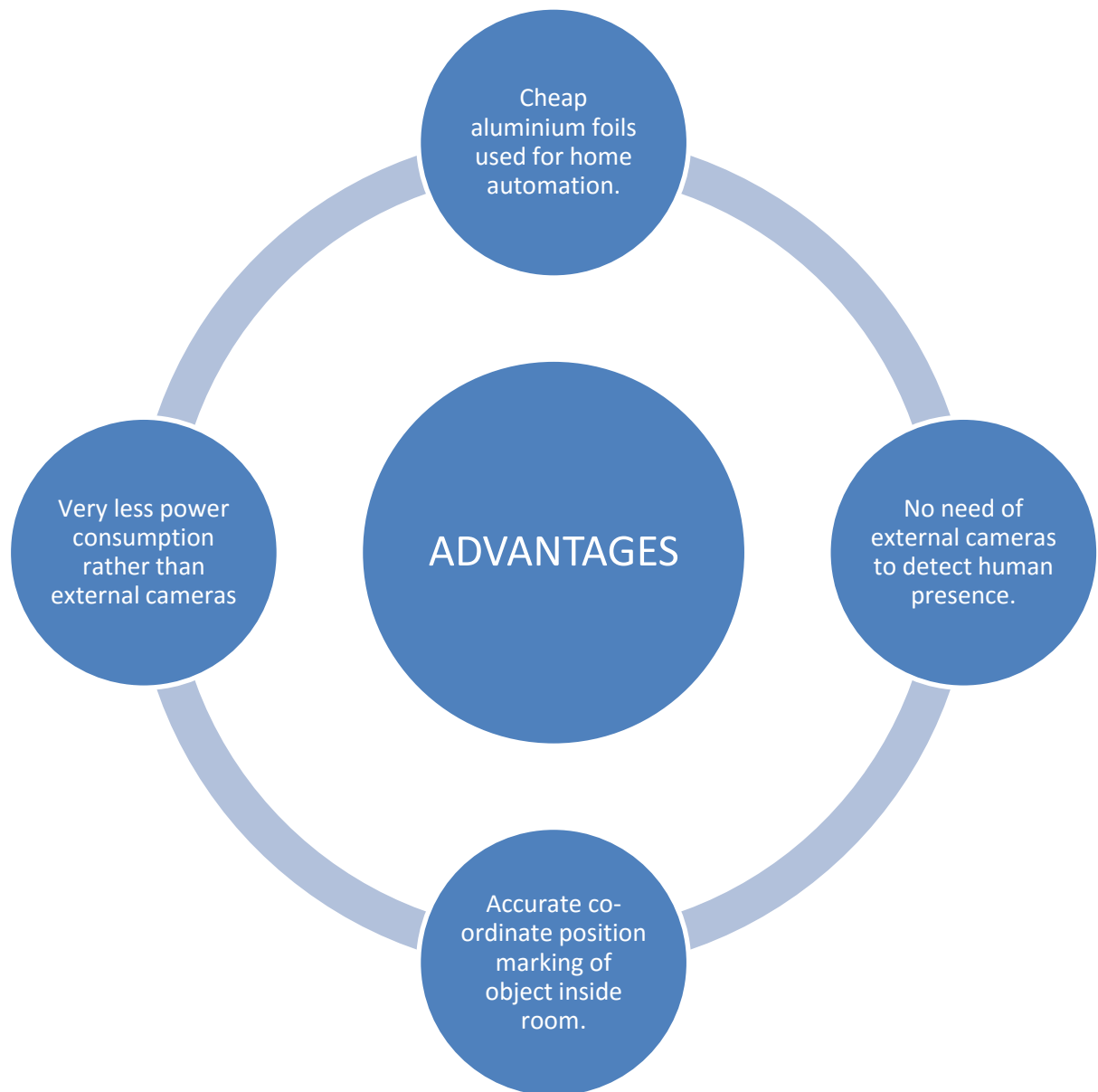


Above a 30% capacitance change was seen by human touch.



By using mains ground for plate discharge and by carefully, adjusting the area of plates and resistor values, we were able to sense human

interference successfully up to 12 cms. For this project a sensitivity of 3 cm is used.



CONCLUSION

In summary of above, we are looking forward to build a cheap, efficient, robust and affordable smart Home Monitoring and Automation system using the principle of *Capacitive Sensing* which aims to take a new step in energy saving and security fields not only for house applications but also on a larger scale like industries, banks, shops etc. and replacing the present expensive home automation system using cameras that is not affordable by common people.