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Motorola Scholar Awards : 2008-2009

Judges decision on the Motorola Awards

Note: You can view the details of the project in PDF format by clicking on the link on each heading of the project title.

First Prize

PROJECT : **WIRELESS CONTROL OF IRRIGATION SYSTEM OPERATING FROM 3 PHASE INDUCTION MOTOR FED BY 1 PHASE SUPPLY**

GUIDE : **Ms. U. DEEPA**

STUDENTS : **N. SANDEEP**

PRANAVAMOORTHY B

COLLEGE : **MEENAKSHI SUNDARARAJAN ENGINEERING COLLEGE, CHENNAI**

Second Prize

PROJECT : **PEER CARE – CHALLENGING THE MONITORING APPROACH THROUGH EMBEDDED SENSORS**

GUIDE : **MR. K. HARIHARAN**

STUDENTS : **S. VINIDHRA**

A. MERCY LATHA

R. NITHYA

COLLEGE : **THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI, TAMIL NADU**

7. WIRELESS CONTROL OF IRRIGATION SYSTEM OPERATING FROM 3ø INDUCTION MOTOR FED BY 1ø SUPPLY

COLLEGE : MEENAKSHI SUNDARARAJAN ENGINEERING COLLEGE, CHENNAI
BRANCH : ELECTRICAL AND ELECTRONICS
GUIDE : U. DEEPA
STUDENTS : N. SANDEEP
PRANAVAMOORTHY B

INTRODUCTION

There have not been any significant technological advancements being made in agricultural sector as compared to other sectors. Irrigation system needs to be monitored on a regular basis. The first aim of the project is to reduce the wastage by automating the entire irrigation system. The three-phase supply system in now available worldwide, except perhaps in some rural areas where only a single phase supply is available. The second aim of our project is to tackle this issue, thereby enabling the operation of these pumps even in the absence of three phase supply.

PROBLEM DEFINITION

The moisture content of the field is not monitored and it is manually observed by the farmers which are prone to errors.

DESIGN AND IMPLEMENTATION

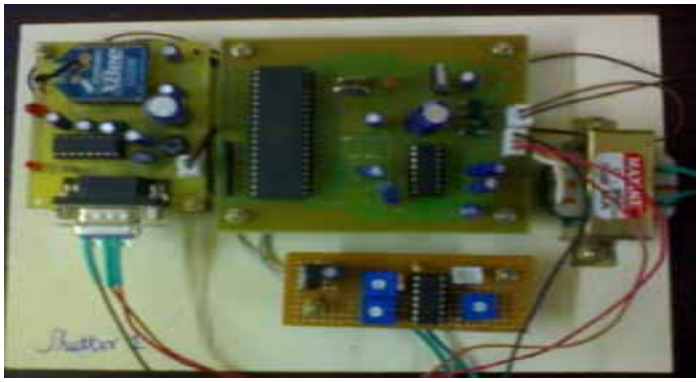
The technical details of the project contain block diagram, circuit connections and detailed explanation of various components used. The analysis is split into two parts

- Automation of irrigation system using wireless communication.

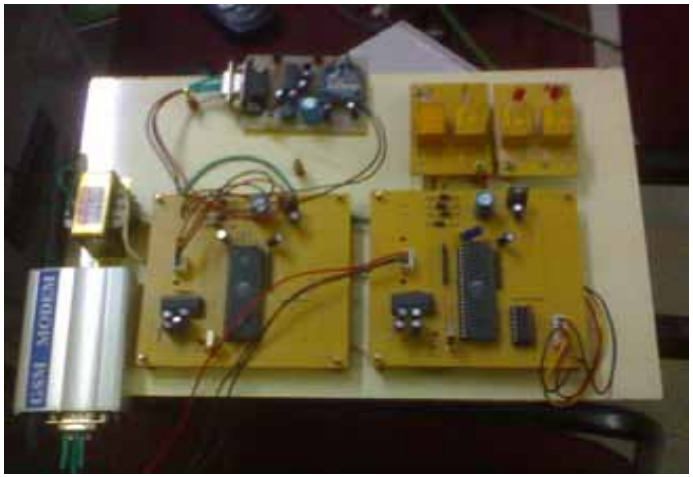
- Operation of a three phase motor pump using single phase supply

Automation of irrigation system using wireless communication

The water or moisture sensor is placed in the field which continuously senses the moisture content in the field. The output of the sensor is transmitted wirelessly using a zigbee module. Another zigbee module at the receiving end receives these transmitted signals and gives it as an input to the main micro-controller which is the control unit. This main micro-controller is programmed to perform the various functions. First, the opening/closing of the shutters is controlled by the main micro-controller depending on the sensor output. Secondly, once all the fields are irrigated to the optimum level a signal is sent to switch off the motor thereby stopping the water supply. Thirdly, the main micro-controller sends all the details of the operations being performed in the field to the farmer's mobile using GSM. The farmer can operate the field either in manual mode or in automatic mode. In the manual mode the farmer will wirelessly control the on/off of the motor and the shutters irrespective of the sensor output. In automated mode, the operation is based on the sensor output as explained above. The picture of the hardware model of irrigation part is given below:



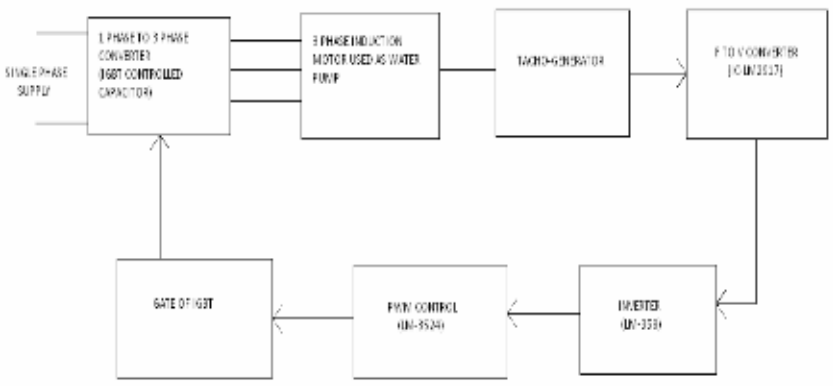
Field 1



Main control unit and GSM module

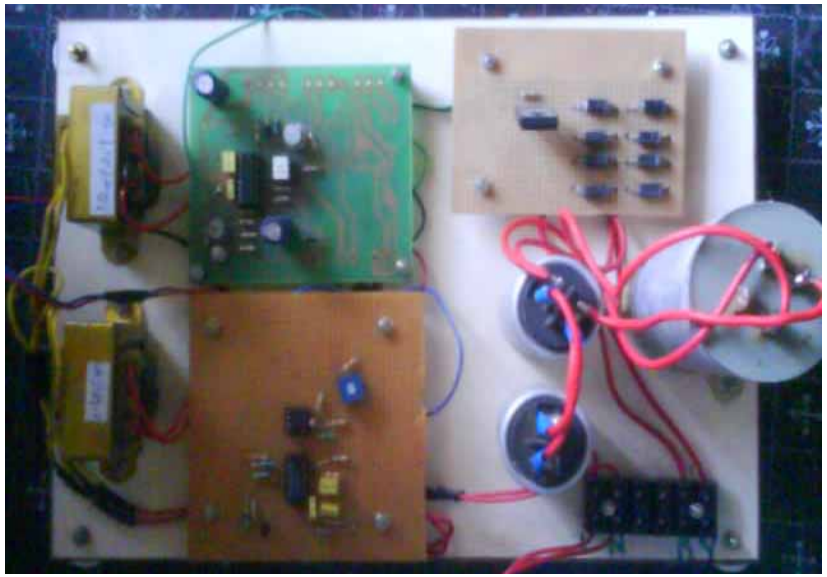
OPERATION:

Single-phase motors are the most common form in the lower horse-power ranges, but they become uneconomical for ratings above about 0.5kW and therefore an increasing tendency to use standard three-phase motors supplied from single-phase supply if the three-phase supply is not available.



The phase and neutral of the single phase supply are given to the two windings of the three phase induction motor. The

third winding is connected to the line through a fixed and variable capacitor, both being parallel to each other. The capacitance of the variable capacitor is varied electronically with the help of an IGBT connected in series with the capacitor. The duty cycle of the IGBT is varied continuously with respect to motor speed as follows. The speed of the motor is obtained using a tachometer. The frequency pulses are tapped out from the tachometer and given to a frequency to voltage converter. The voltage level which is proportional to the frequency is given as the reference input to the comparator whose other input is the saw tooth waveform. The pwm pulse obtained is given as the gate pulse to the IGBT. Hence as the speed varies the voltage level and hence the duty cycle of the IGBT varies thereby varying the net capacitor value. This continuous variation of capacitance with respect to speed maintains minimum unbalance between the three phases of the induction motor. An opto-coupler is used in order to isolate the low voltage electronic circuit from power circuit.



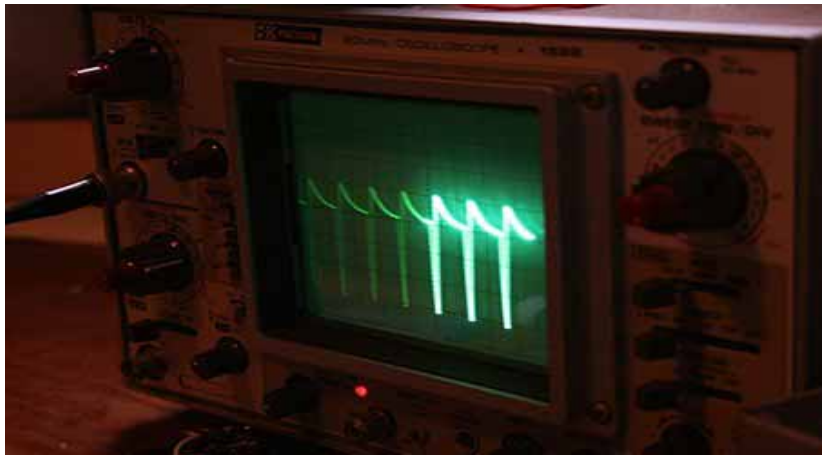
TESTING

In the automation part the reference of the comparator of the moisture sensor is set to 4.54V. When the field is dry, the sensor produces an voltage of 4.81V and hence the comparator output will be high. The sensor gives an output voltage of 3.2V during wet condition and the comparator output will be at zero volts. This output is converted to serial data with the microcontroller for Zigbee transmission. After Zigbee transmission, the GSM module either transmits or receives messages as per the mode of operation. The tacho generator is coupled with the motor to get the desired speed. This gives the frequency pulses as output. There is a digital tachometer connected to this which reads the motor speed. These frequency pulses obtained are spike waveforms.This output from the tacho generator is amplified and fed to the frequency to voltage converter to get appropriate voltage for the corresponding speed of motor. As the pulses obtained are very less in magnitude, an amplifier circuit is used and then it is converted to voltage pulses. The output voltage thus obtained is about 2V. The output obtained from the F to V converter is fed to the inverter LM 358 so that the voltage varies in direct proportion to frequency. The magnitude remains same (2V). The DC voltage output got from the F to V converter and inverter circuit acts as the reference and cuts the saw tooth waveform to get the PWM output. These PWM pulses are fed to the base of the IGBT and hence switching of the IGBT is controlled by the PWM output. This in turn controls the net capacitance of the circuit.

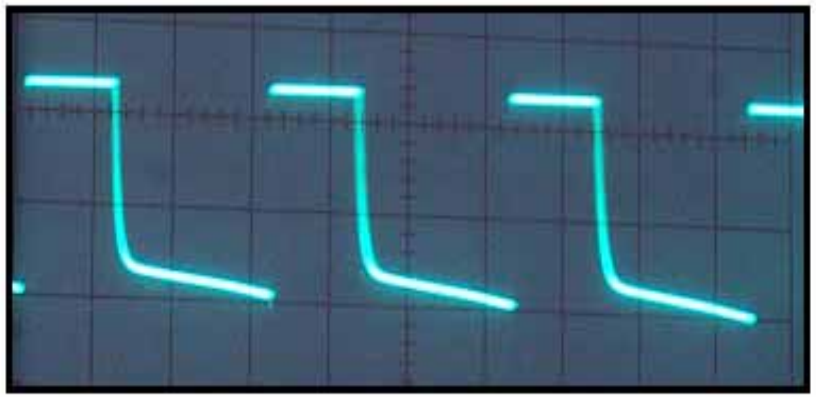
ADVANTAGES

- No centrifugal switch
- Less harmonics
- No zero current switching

- Steady state current minimized
- Less maintenance cost
- More economical
- Better efficiency



Frequency pulses



Input to IGBT gate

APPLICATIONS

- Woodworking machines

- Ice cream mixture and compressor
- Agricultural
- Horticulture

LIKELY PROBLEMS THAT MAY BE ENCOUNTERED

- Water level sensors should be placed in appropriate place such that there is uniform distribution of water all over the area, else the water level sensors might give a wrong output.

- The ratings of the capacitors are decided based on the impedance of the circuit: - If the capacitors are not designed properly the capacitors may even burst.

- As high voltage capacitors are used the switch should be capable of withstanding the high voltage surges produced hence care should be taken while deciding the rating of the IGBT.

CONCLUSION

The design and implementation of a controlled capacitor for a three-phase induction motor operating from single phase supply has been presented by using a fixed capacitor in series with an electronic switch. The proposed system eliminates the use of mechanical or centrifugal switches which is located inside the motor. This avoids the possibility of the switch failure and leads to less operational and maintenance cost and improves the system reliability. The optimum effective capacitor value can be on-line adjusted at any operating speed by periodically changing the duty cycle of the controlled switch to achieve minimum unbalance in phase voltages or any other optimization criteria to improve the motor performance at different speeds. With the output obtained from the hardware module, it can be inferred that

the automation of the irrigation system is highly feasible so that the irrigation can be done even without the presence of farmer.

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- Volume II AC and DC machines, S.Chand publications, reprint 2007.
- AT89C52 data sheet
- LM2917 datasheet
- LM3524 datasheet
- Zigbee user guide
- GSM user guide

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10. PEER CARE – CHALLENGING THE MONITORING APPROACH THROUGH EMBEDDED SENSORS

COLLEGE : THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI.
BRANCH : ELECTRONICS AND COMMUNICATION
GUIDE : MR. K. HARIHARAN
STUDENTS : A. MERCY LATHA
S. VINIDHRA
R. NITHYA

INTRODUCTION

With the rising count of dependent population, the necessity for ad hoc care and intensive monitoring has been gaining excessive attention lately. Care takers prefer a system that automatically reports on the activity of their peer and alert them on any mis-hap. Home environments that can monitor automatically the activities of their occupants ,can help extend independence, quality living and reduce healthcare costs. In particular , patterns of inactivity can be used to make inferences about health and to help detect falls. It is important to note that the significance of inactivity changes with context.

Detection of a falling person in an unsupervised area is a practical problem with applications in safety and security areas including supportive home environments and CCTV surveillance systems. Intelligent homes make use of a multitude of sensors including surveillance cameras. Currently used worn sensors include passive infrared sensors, accelerometers. However, they may produce false alarms and elderly people simply forget wearing them very often.

OBJECTIVE

Automatic semantic summarisation of human activity and detection of unusual inactivity are useful goals for a

monitoring system operating in a supportive home environment. Our system aims at ***detection of fall****-one of the primary reasons for sudden inactivity*. The method presented here enables detection of inactivity outside usual zones of inactivity (e.g. chairs, beds). When combined with body pose and motion information this should provide a useful clue for fall detection. In addition, a human-readable description of activity in terms of semantic regions provides a useful summary of behaviour.

PROBLEM DEFINITION

- To develop a monitoring system that collects information about the occupants of a house who require special care and alert their care taker if a fall is detected.

- To develop a monitoring system that overcomes the drawbacks of the existing monitoring approaches, some of which are:

  - Use of cameras for monitoring may intrude the privacy of the person monitored. For example, placing of cameras inside lavatory might be unethical and might intrude the person's privacy. The cost of implementation is high and requires lots of cameras to monitor a large area and a house with large number of rooms. This method requires complex image processing algorithms.

  - Wearing of sensors along with the clothes is another existing system. It has lots of issues. For instance, Alzheimer's patients frequently strip themselves of clothing, including any wearable sensors. Elderly individuals are also more sensitive to small changes in environment.

APPLICATIONS OF THE SYSTEM

The primary applications of our project are highlighted below.

Figure 1. Picture depicting various situations where monitoring is necessary

- **REMOTE MONITORING OF DEPENDENT PEOPLE:** Remote monitoring of people with this system reduces the stress level of the care giver. This system can be used to monitor an aged person or a small child or people with physical or cognitive disorder. It gives details of their activity. It also alerts the care taker when a fall is detected.

- **SURVEILLANCE:** To monitor any intrusion inside the restricted area. To alarm a person about the status of his haunted house and to alert them in case of entry of aliens or robbers. To detect any intrusion in banks where valuables are placed.

DESIGN APPROACH AND DESIGN

An illustration of our system is shown below

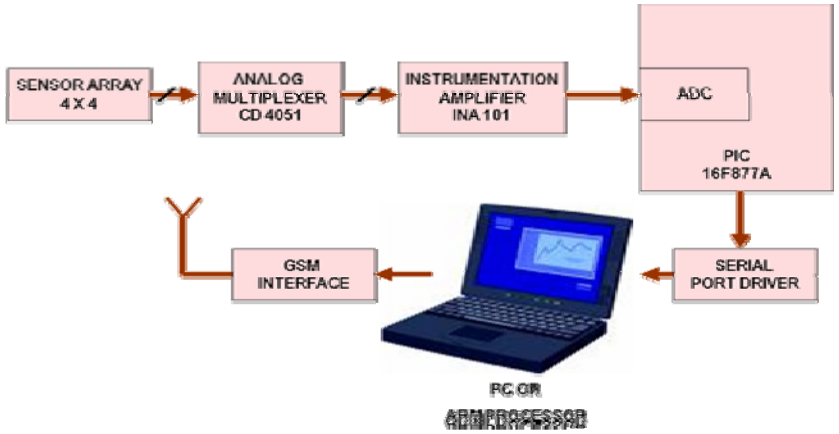


Figure 2. Block diagram of our system

The sensors are placed in the form of a matrix in between the tiles and the data is taken parallelly from all the points in a room. The sensors must be placed with a spacing of ½ feet between each other. The analog multiplexers(4051)are used to collect data from different sensors simultaneously. The analog multiplexers are used because the voltage output of the sensors will be in the range 0-100mv.The instrumentation amplifier is used to amplify the very small voltage produced by the sensors and are used to manipulate the differential voltage across the sensors. The analog voltage is amplified to such a level that they can be converted to digital form using the PIC. The PIC 16f877A is used to collect the amplified differential voltage from instrumentation amplifier and convert it to digital form. It stores the data. The data is collected every second and is stored. The PIC data is fed into the ARM processor or PC for applying our algorithm and manipulating results. We currently use ***MATLAB TOOL*** for implementing our algorithm. We make use of ***change detection*** as our key idea behind the fall detection.

SENSORS-STRAIN GAUGES

Strain gauges are devices whose electrical resistance varies in proportion to the amount of strain in the devices. The most widely used gauge is the bonded metallic strain-gauge which consists of a very fine wire or metallic foil arranged in a grid

pattern. The grid pattern maximizes the amount of foil subject to strain in the parallel direction .The cross-sectional area of the grid is minimized to reduce the effect of shear strain and Poisson strain. The grid is bonded to a thin backing, called the carrier, which is attached directly to the test specimen.

Therefore, the strain experienced by the test specimen is transferred directly to the strain gauge, which responds with a linear change in electrical resistance. The figure 3 on the left shows a metallic strain gauge and the strain gauge implemented in a cantilever system is at the right.

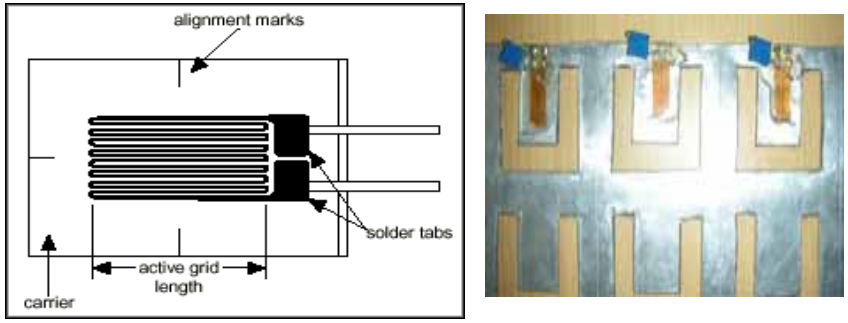


Figure 3. Strain Gauges

The strain gauges are bonded to an aluminium plate in a cantilever structure as shown and the voltage is measured across a bridge circuit. The bridge circuit is formed with strain gauge as one of the resistance forming the bridge. We have used strain gauges of value ***120 ohm.*** The bridge is balanced with the pot. When a strain is applied over the gauges the bridge gets unbalanced. There is a raise in the voltage from absolute zero to few milli volts.

The change in voltage will be only in the order of 0.1 milli volts for every 1 kg increase in weight placed on the cantilever system. This output is taken from every sensor node and fed into the multiplexer. The analog multiplexer 4051 switches between each sensor nodes and passes the analog input into the instrumentation amplifiers. The

instrumentation amplifier is tuned to a gain of 100. The figure 4 shows the circuit design.

Instrumentation amplifier Gain = 1+ (40kΩ/R_G)

The resistance R_G is the resistance used to vary the gain of the instrumentation amplifier. Its value is tuned to around 404 ohm for a gain of 100.

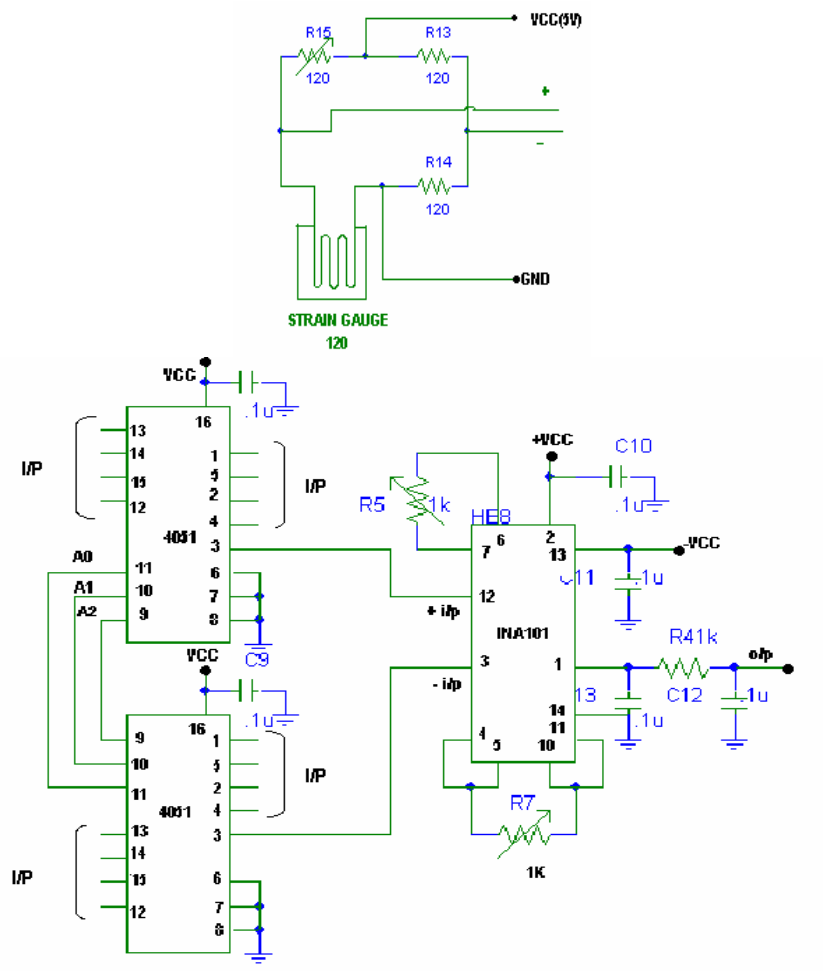


Figure 4. Bridge circuit and the instrumentation amplifier circuit

The PIC 16f877A has analog to digital converters. The pins 2 to 7 are adc channels. We can make use of any one of the channels to feed the analog input. The PIC is programmed to acquire the data and the digital output is stored and forwarded to the personal computer. The personal computer makes use of the ***matlab tool*** for processing. The figure 5 shows the PIC circuit and the serial interface.

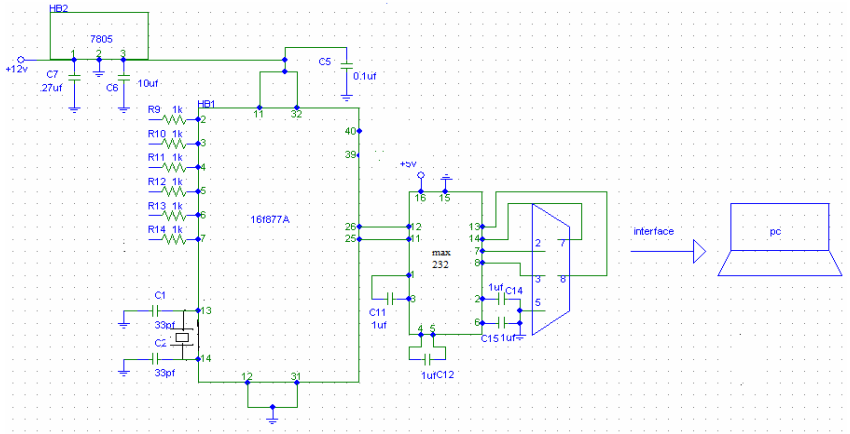


Figure 5. PIC circuit and serial interface

TESTING AND IMPLEMENTATION

TEST RESULTS

The sensor data is taken for processing every second. The voltage levels in digital form are compared with its previous frame for any change. The difference in the frames is stored in the database for future reference. If the change is catastrophic, then there is an indication of abnormality. The threshold is fixed based on the real time data taken from the sensors.

Various weights like 1kg, 2kg upto 80 kgs are placed on the cantilever system. The voltage is acquired by the PC using the data acquisition system. The voltage matrix is first stored in the database.Then change in weight for every kg is plotted. This data gives us a static response of the system. The voltage levels obtained will be in the order of millivolts. The

difference for each kilo gram rise is in the order of few micro volts. The threshold is fixed based on this value.

The graph is plotted with the test data and shows the linear increase in the sensor voltage for a constant increment in the weights. The data obtained every second is compared with the threshold matrix and the previous frame. If an abnormal peak is detected an alert message is swiftly sent to the care taker through the GSM system.

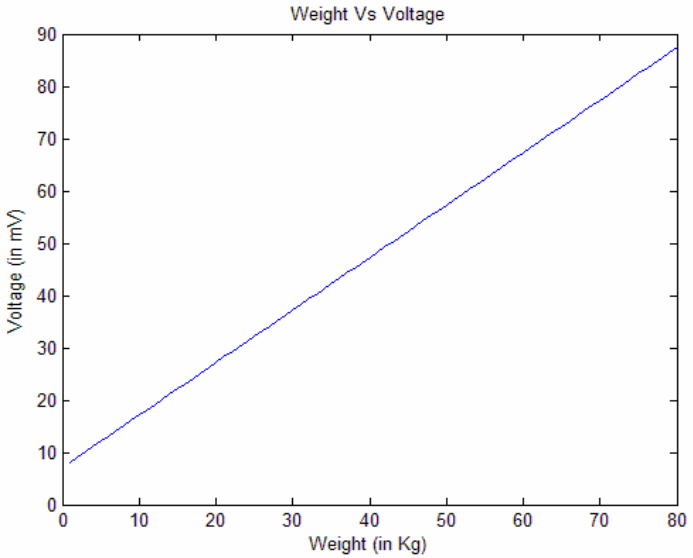


Figure 6. weight vs voltage plot

IMPLEMENTATION

For child monitoring, an average weight of 20Kg is assumed. From the results of testing, it is quite evident that the corresponding static response would be around 27mV.The threshold voltage is set to approximately 35mV, considering all the likely issues to be encountered. The sensor data are compared with the previous frame and the threshold value. As the above sequence of frames hold the voltage values falling below the threshold voltage and comparable with the previous frame voltage values, it is identified as a normal activity. Considering the sequence of frames, a peak voltage

of about 40mV is noticed, which obviously exceeds the threshold and so is identified as an abnormal activity. Whenever there happens to be an abnormal condition, the GSM module is activated, which immediately sends an SMS to the care-taker. Further, a warning window too appears intimating the care-taker about the abnormal activity.

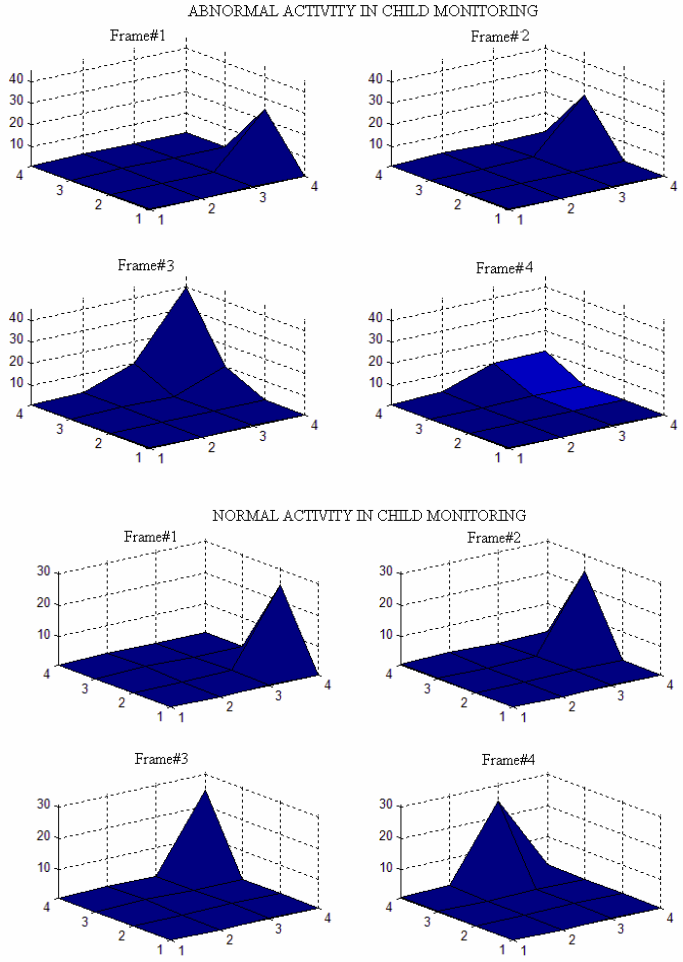


Figure 7. Graphs plotted for the data manipulated for a small child

SNAPSHOTS OF THE SYSTEM

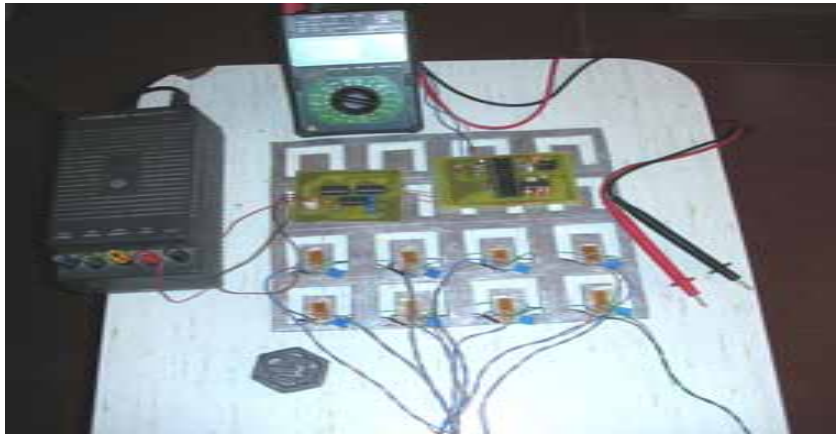
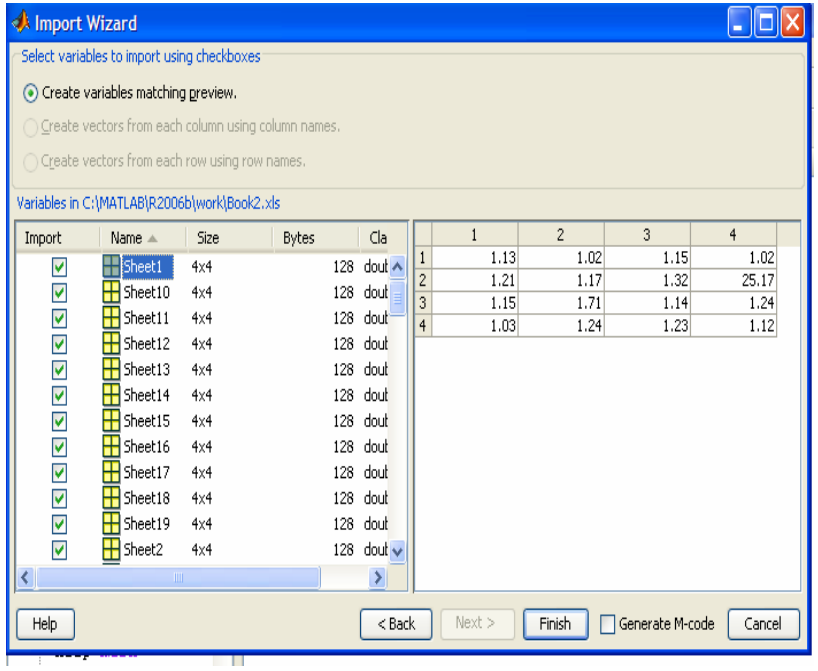


Figure 8. The monitoring system



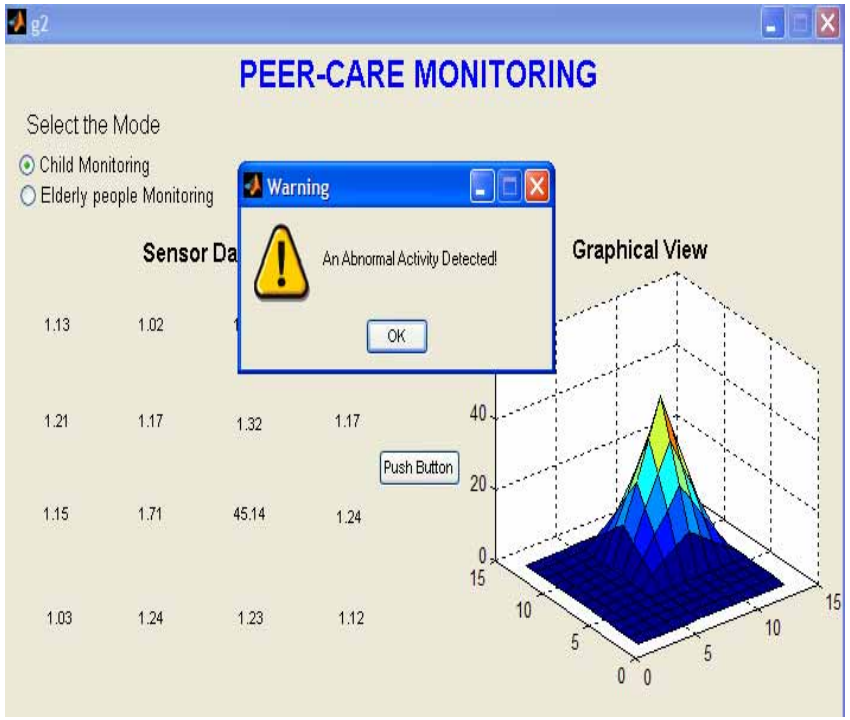


Figure 9. The data display window and the database display

PROBLEMS ENCOUNTERED

The project was proposed to be done with piezo electric sensors. But their acquisition was found to be difficult. So we had to go for strain gauges. The strain gauges are highly temperature sensitive. They tend to shift the bridge balance often. But this is overcome by the placement of pot in the bridge to tune the ratio formed by the sensor and pot to be equal to the resistor ratio.Fixing of the sensors in the form of cantilever system is a major requirement. The cantilever design required great mechanical work and its application. The metal we chose to make the cantilever was aluminium. But it couldn't recover from the strain applied swiftly. This produces a shift in the output. Changing the metal with greater elasticity is an apt solution.

FUTURE WORK

- This system is currently tested for remote monitoring of elders and young children. This will be extended for surveillance. The algorithm will be remodified for the purpose of surveillance.
- This is currently tested in pc it can be implemented in ARM processor and can be made portable and cost effective.
- The system makes use of strain gauges. It will be tested with the piezo electric sensors.

CONCLUSION

Thus we have designed a system that monitors the elders and the children. This system can be implemented anywhere inside the house on the floor. The reliability of the system can be interpreted from the real time data acquired. The system is designed in such a way that it aptly alerts the care giver and reduces his stress levels and worries about his peer.

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Herald

Motorola awards for Tamil Nadu colleges

BANGALORE, DHNS: Two colleges from Tamil Nadu clinched this year's Motorola Scholar Award, instituted by a City-based trust, the Foundation for Advancement of Education and Research (FAER) on Wednesday.

A project dealing with reduction of wastage by automating the irrigation system by Chennai's Meenakshi Sundararajan Engineering College won the first prize, while Madurai's Thiagarajar College of Engineering came in the second place, for their project, on a system that enabled people to monitor the activities of their peer or family members and send an alert if there was any accident.

The two projects were selected amongst 11 entries, that came from final year engineering students from across the country, by five judges-three IISc faculty, one official from Motorola and one from Integra Micro Systems Pvt. Ltd. The selection criteria were technical application, display of some innovative idea and practical application.

Around 1,400 engineering colleges are sent details about the award every year.