**Final project report**

**Draft-1**

**Arduino based sensor data acquisition and Simulation**

**(Live in Pspice)**

Instructor- Dr. Saeid Mosleh­­­­­pour

By

Swetha somaram------------------ 19557483

Mohammad Manzur Murshid----19666618

Table of Contents

**Abstract3**

**Introduction4**

**Microcontroller4**

**Open source hardware4**

**Review of literature………………………………………………………………………………5**

**Method …………………………………………………………………………………………...6**

**Result……………………………………………………………………………………………..7**

**Simulation………………………………………………………………………………………..6**

**Futer scope……………………………………………………………………………………….9**

**References…………………………………………………………………………...9**

**List of figures:**

**Circuit diagram…………………………………………………………………………..8**

**Figure 1 temperature sensor data showing different values …………………………..8**

**Figure 2 light sensor data from photo resister ..................................................................9**

**Figure3 Arduino circuit with sensors……………………………………………………..9**

**ABSTRACT**

As an engineers, designers, hobbyists and anyone who nurture with technology for a low-cost, easy-to-use technology to create their creative, interactive objects, useful projects etc., A whole new level of projects can now be built that can be controlled from a computer.

The present work has been concentrated to environmental parameters such as temperature, light detection, angle detection and others. The data logger which is particularly the Pspice which is proposed to be developed with the use of Arduino Uno based on ATmega328 microcontroller IC. The Arduino Microcontroller board is used which has inbuilt ADC and other peripheral circuitry necessary for operation. The physical parameter is sensed by the sensors and is converted into analog signal. This analog signal is fed to the Arduino board ADC pins which is then converted in to an equivalent digital quantity and is further processed in the microcontroller. The raw digital signal or processed signal out of microcontroller will be displayed on the Pspice simulation. This data is sent to computer through the USB serial port.

**INTRODUCTION:**

Arduino is a open source electronics prototyping platform based on flexible, easy-to-use hardware and software. It’s intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. It’s an open-source physical computing platform based on a microcontroller board, and a development environment for writing software for the board. In simple words, Arduino is a small microcontroller board with a USB plug to connect to your computer and a number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc., They can either be powered through the USB connection from the computer or from a 9V battery. They can be controlled from the computer or programmed by the computer and then disconnected and allowed to work independently.

**Microcontroller:**

Microcontroller can be described as a computer embedded on a rather small circuit board. To describe the function of a microcontroller more precisely, it is a single chip that can perform various calculations and tasks, and send/receive signals from other devices via the available pins.

Precisely what tasks and communication with the world it does, is what is governed by what instructions we give to the Microcontroller. It is this job of telling the chip what to do, is what we refer to as programming on it. However, the microcontroller by itself, cannot accomplish much; it needs several external inputs power, for one; a steady clock signal, for another. Also, the job of programming it has to be accomplished by an external circuit. So typically, a microcontroller is used along with a circuit which provides these things to it; this combination is called a microcontroller board. The actual microcontroller at its heart is the chip called

**Atmega328:** The advantages that Arduino offers over other microcontroller boards are largely in terms of reliability of the circuit hardware as well as the ease of programming and using it

**Open-source hardware:**

Open-source hardware shares much of the principles and approach of free and open-source software. The founders of Arduino wanted people to study their hardware, to understand how it works, make changes to it, and share those changes with the world. To facilitate this, they release all of the original design files (Eagle CAD) for the Arduino hardware. These files are licensed under a Creative Common Attribution Share-Alike license, which allows for both personal and commercial derivative works , as long as they(people) credit Arduino and releasetheir designs under the same license. The Arduino software is also open-source. The source code for the Java environment is released under the GPL and the C/C++ microcontroller libraries are under the LGPL.

**Pspice:**

PCB design teams need fast and reliable simulation to achieve convergence. Cadence® PSpice® simulation technology offers a single, unified design environment for both simulation and PCB design. With integrated analog and event-driven digital circuit simulation, teams benefit from improved speed without sacrificing accuracy. Using advanced analysis circuit analysis software, designers can automatically maximize the performance of circuits.

**REVIEW OF LITERATURE:**

**HISTORY OF ARDUINO:**

The first Arduino was introduced in 2005, based on 8-bit [Atmel AVR](https://en.wikipedia.org/wiki/Atmel_AVR), aiming to provide a low cost, easy way for novices and professionals to create devices that interact with their environment using [sensors](https://en.wikipedia.org/wiki/Sensor) and [actuators](https://en.wikipedia.org/wiki/Actuator). Common examples of such devices intended for beginner hobbyists include simple [robots](https://en.wikipedia.org/wiki/Robot), [thermostats](https://en.wikipedia.org/wiki/Thermostat), and motion detectors.

Arduino comes in a variety of different boards. Arduino boards are available commercially in pre-assembled form, or as [do-it-yourself](https://en.wikipedia.org/wiki/Do-it-yourself) kits. The hardware design specifications are openly available, allowing the Arduino boards to be produced by anyone. In mid-2011, it was estimated that over 300,000 official Arduinos had been commercially produced, and in 2013 that 700,000 official boards were in users' hands.

While teaching a physical computing class at the Interaction Design Institute Ivrea in 2005, Massimo Banzi’s students were unwilling to spend the 76 euros for the BASIC Stamp microcontrollers commonly used in such applications. Banzi and his collegues looked foralternatives, finally settling on the wiring platform developed by one of Banzi’s students. In his own words. we started to figure out how could we make the whole platform even simpler, even cheaper, even easier to use. And then we started to essentially re-implement the whole thing as an open source project.  Once they had a prototype, a student wrote the software that would allow wiring programs to run on the new platform. Upon seeing the project, visiting professor Casey Reas suggested that there might be wider applications than just design schools for the new product. The prototype was re-designed for mass production and a test run of 200 boards was made. Orders began coming inform other design schools and the students looking for Arduinos, and the Arduino project was born and Massimo Banzi and David Cuartielles became its founders. ARDUINO is an Italianword, meaning ―STRONG FRIEND.The English version of the name is Hardwin. As of May2011,more than 300,000 Arduino units are ―in the wild.

**Recent research:**

In recent years with arduino now we can capture various inputs and sensors data as well. In this context we have decided to capture the sensor data using the arduino as a heart and we will demonstrate the simulation result directly in the Pspice which was never possible previously. As the new version of Pspice is out there we can now do the Hardware in the loop project using arduino. In this research we will try to demonstrate this idea.

**METHOD :**

**Materials and Procedures:**

The data acquired may be important in such systems but the cost of acquisition shoots up the system cost making it an economic constraint for project developers. The present DAQ systems are costly, this project intends to develop a product which beats the present market cost of the DAQ with additional features such as database storage with real time plotting of collected data. This concept is implemented using microcontrollers and sensor circuits which are developed and are custom designed as per the physical data to be captured. Usual 8051 microcontroller uses external ADC which is interfaced with it and converts the analog signal fed into digital signal which is then fed to microcontroller for processing. Here in this project Arduino Microcontroller board is used which has inbuilt ADC and other peripheral circuitry necessary for operation. The physical parameter is sensed by the sensors and is converted into analog signal.

This analog signal is fed to the Arduino board ADC pins which is then converted in to an equivalent digital quantity and is further processed in the microcontroller. The raw digital signal or processed signal out of microcontroller may be displayed on the Pspice simulation. This developed product can be readily implemented in industry for logging of any physical quantity such as temperature, humidity or pressure etc. The project is even suitable for digital signal processing of a physical signal into computational software like MATLAB

**COMPONENTS:**

**SYSTEM COMPONENTS:**

It consists of three components which are as follows:

1) Sensors 2) Arduino 3) Pspice simulation software

**DESCRIPTION OF MODULES :**

1. **TMP-36 temperature Sensor:** The TMP36 is a low voltage, precision centigrade temperature sensor. It provides a voltage output that is linearly proportional to the Celsius temperature. It also doesn’t require any external calibration to provide typical accuracies of ±1°C at +25°C and ±2°C over the −40°C to +125°C temperature range. We like it because it’s so easy to use: Just give the device a ground and 2.7 to 5.5 VDC and read the voltage on the Vout pin. The output voltage can be converted to temperature easily using the scale factor of 10 mV/°C.
2. **ADXL335-Triple Axis sensor:**  Breakout board for the 3 axis ADXL335 from Analog Devices. This is the latest in a long, proven line of analog sensors - the holy grail of accelerometers. The ADXL335 is a triple axis MEMS accelerometer with extremely low noise and power consumption - only 320uA! The sensor has a full sensing range of +/-3g.

There is no on-board regulation, provided power should be between 1.8 and 3.6VDC.

Board comes fully assembled and tested with external components installed. The included 0.1uF capacitors set the bandwidth of each axis to 50Hz.

1. **PhotoResistor**: A photoresistor (or light-dependent resistor, LDR, or photocell) is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity.
2. **Force Sensor:** This is sensor is able to sense the force of a finger is generating by pressing the sensor. This sensor act as: when the force is greater the resistivity is lower and gets higher when the pressure is low.

**RESULT**:

Developed sensors are interfaced to microcontroller and are calibrated comparing with standard measuring instruments. The rig is tested for number of days, after calibration the parameters are plotted with respect to time of day. The variation of measured parameters is studied and suitable conclusions are drawn after few days of exhaustive field tests. These measured parameters are displayed in real time on the PC using the Pspice simulation.

**SIMULATION:**

In this project we are using the new software update release of Orcad Pspice version 17.2. As this version currently supporting the Hardware virtualization and Hardware in the loop, which Arduino plays the part for central processing unit of the circuit and gives the simulation, live. In our project we are using TMP- 36 temperature sensor and photo diode resister for detecting the light and TILT sensor. In our project the arduino board is taking the input data from the sensors and that data is transferred to the Pspice for live simulation.



Fig: Circuit designed in the Pspice



Figure 1: Temperature Sensor data showing different value according to temp change

Figure 2: Light sensor data from the Photo resistor sensor.

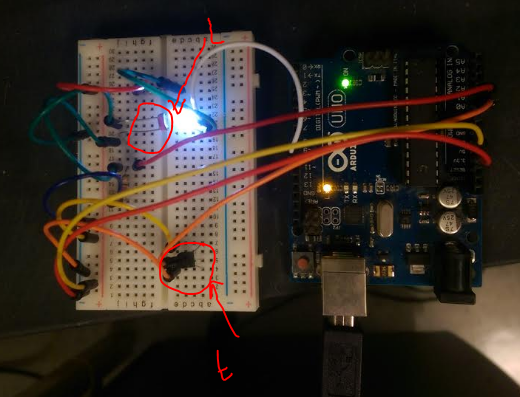


Figure 3: Arduino circuit with sensors

t.= Temperature sensor

l. = Light detector(LDR)

**FUTURE SCOPE :**

This system can be altered marginally to log and record other physical signals rather than temperature, humidity or pressure in requisite application.

Product can be custom build to suit prerequisite accuracy and presision of measurement by upgrading the analog to digital converter rather than using inbuilt 10 bit converter embedded in microcontroller. Data aquired can be imported further into computational softwares like MATLAB, Python for mathematical computaions. Multiple channel data acquition can be implemented using collective number of sensors connected to analog or digital inputs respectively as per sensing parameter and sensor specifications.

**REFERENCES:**

1. [Arduino - Introduction"](http://arduino.cc/en/guide/introduction). arduino.cc
2. Schmidt, M. ["Arduino: A Quick Start Guide"], [Pragmatic Bookshelf](https://en.wikipedia.org/wiki/Pragmatic_Bookshelf), January 22, 2011, Pg. 201
3. [Arduino RS232 official webpage; arduino.cc](https://www.arduino.cc/en/Main/ArduinoBoardSerial)
4. [Arduino Diecimila official webpage; arduino.cc](https://www.arduino.cc/en/Main/ArduinoBoardDiecimila)
5. [Arduino Duemilanove official webpage; arduino.cc](https://www.arduino.cc/en/Main/ArduinoBoardDuemilanove)
6. [Arduino Uno official webpage; arduino.c](https://www.arduino.cc/en/Main/ArduinoBoardUno)