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DATA ACQUISITION SYSTEM USING LABVIEW

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Abstract – *Traditional Data Acquisition Systems are bulky and very expensive. These system have their own drwabacks, like being complex and not being usefull to students or professionals for small scale applications or projects with low budget. The purpose of our project is to construct a high speed Data Acquisition System using LabVIEW and AVR family microcontroller which is compact and made of low cost components making it handy and affordable. The basic idea is to design DAQ system & Pocket CRO which can display & record a precise waveform. For demonstration, we are going to use many sensors (light, temperature etc) for analog input to the AVR microcontroller ATmega32.Using this project we are going to get 30,000 samples per sec of signal using LabVIEW i.e. 30 samples values at each millisecond will be recorded and saved on an excel sheet.*

Key Words: LabVIEW; data acquisition; LIFA; DSO; AVR Family.

1. INTRODUCTION

The main objective is to implement a low cost acquisition system intended for control applications using the AVR family prototyping platform. AVR family microcontroller has become a popular open source single-board microcontroller among electronic hobbyists, and it is gaining acceptance as a quick prototyping tool for engineering and educational projects also the system meets the following requirements suitable for educational purpose:

- Low cost: The components are affordable.
- Easy to assembly due to the constitution of the modules.
- Able to run on different platforms: the overall system can operate in different operating systems.
- Open hardware and open source: This means that the hardware and the software used has a public access.
- Anyone can use it and improve it.
- Suitable for control applications
- Bidirectional: It is possible for data to be transmitted in both directions via USB serial communication.
- Wired / Wireless connection Autonomous or independent system

2. PROPOSED METHOD

In the entire engineering studies, we have studied and used many systems for calculation and measurement of signals (analog and digital) like CRO (CATHODE RAY OSCILLOSCOPE) and DSO (DIGITAL STOARAGE OSCILLOSCOPE). But there are few limitations we have to face in these systems like for higher amplitude signal there is no convenient way to observe the waveform and due to circuit internal noise many fluctuations can be seen on the display of the oscilloscope which are undesirable for the minute sampling and data collection for samples, there is also the problem of external noise and there is no such facility to store the waveform

So to overcome all this problems regarding traditional oscilloscope, we are going to implement a system which will be using the hardware and software together to calculate the waveforms, analyze and store the waveform. We are going to implement the new data acquisition system using LabVIEW software and AVR family platform. The system will be able to store the waveform also there won't be any noise generated in the circuitry (internal or external) as we are going to connect the computer having LabVIEW installed with the AVR Board with USB parallel port connection.

Using "HIGH SPEED DATA ACQUISITION SYSTEM USING LABVIEW" we are going to make a DAQ as product which will be used to analyze the waveform and will generate minimum 30,000 samples at a second of the time, adding to it, the software gives us the facility to save the recorded 30,000 samples on the excel sheet.[1]

Please refer Figure no. 1 for basic Block Diagram.

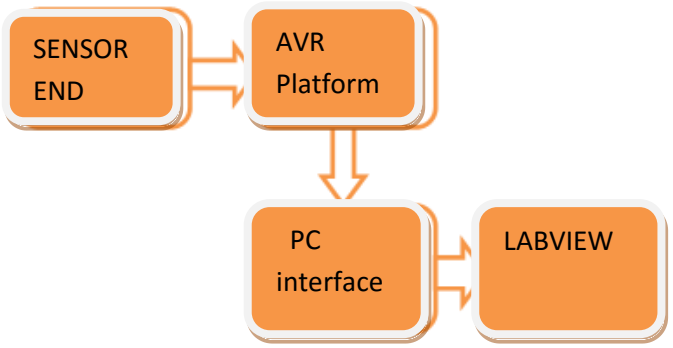


Fig -1: Block Diagram of our project

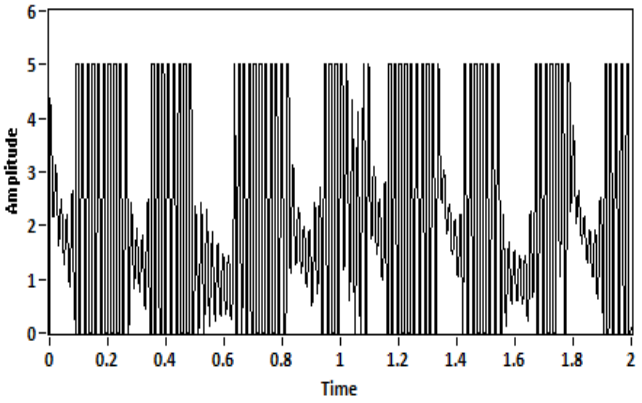
3. DAQ USING LabVIEW

A computer, using a control application done in LabVIEW, controls all the system by cable or wireless. This control application display all the data obtained from the acquisition system, and save it into a file document in order to obtain a history of the measures. In this project various sensors like Infrared sensor, Light Dependent Resistors (LDR), Analog POT are used and there data is gathered using AVR microcontroller and LabVIEW.[2]

3.1 LabVIEW:- AVR Microcontroller Interaction with physical world.

AVR families are tiny computers with a bunch of analog and digital Input/output channels. You write programs for them and send them via USB to the device. With the appropriate program (firmware) you can have your AVR family duplicate the functionality of the USB-600x, but with much less impressive resolution and sample rate. The AVR family analog inputs are only 8-bit and my best estimate of the sample rate is roughly 30000 samples per second.

Fig -2: Example Samples Taken in 1 Second



3.2 Application Program

The application program is developed with Microsoft C# programming language using Microsoft Visual Studio framework and it gives a user interface for the security system. The advantages of Microsoft C# programming language are its rigidness, easy to program, has an excellent database connectivity, works on the two most common operating system platforms (Windows and Unix) and it has a greater user community that provides online support.

4. LabVIEW Toolkit: LIFA

The NI LabVIEW toolkit helps us easily to interface LabVIEW software with AVR microcontroller. With this toolkit and LabVIEW, you can control or acquire data from the AVR microcontroller. Once the information is in LabVIEW, analyse it using the hundreds of built-in LabVIEW libraries, develop algorithms to control the AVR hardware, and present your findings on a polished User Interface (UI). A sketch for the AVR microcontroller acts as an I/O engine that interfaces with LabVIEW VI's through a serial connection. This helps you quickly move information from AVR pins to LabVIEW without adjusting the communication, synchronization, or even a single line of C code. Using the common Open, Read/Write, close convention in LabVIEW, you can access the digital, analog, pulse-width modulated, I2C, and SPI signals of the AVR microcontroller[3]

Fig -3: LabVIEW Block Diagram CRO

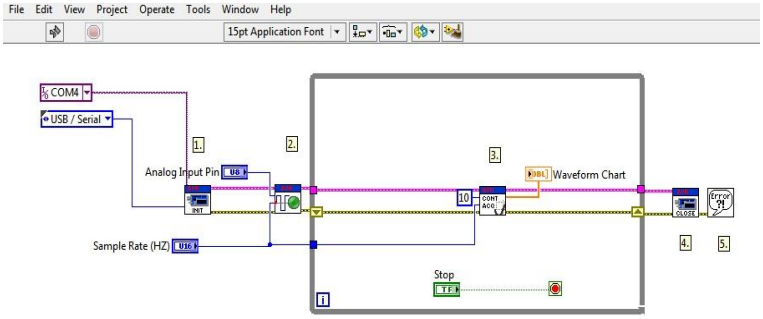


Fig -4: LabVIEW Front Pannel CRO

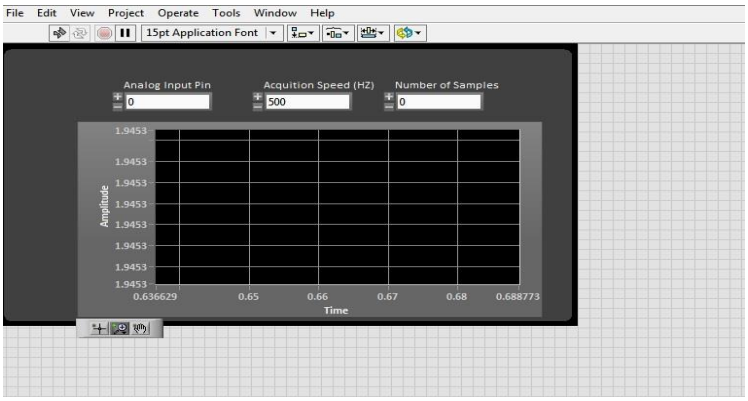


Fig -5: LabVIEW Block Diagram DAQ

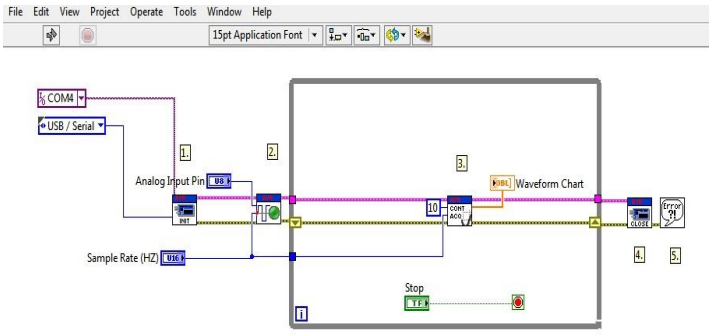
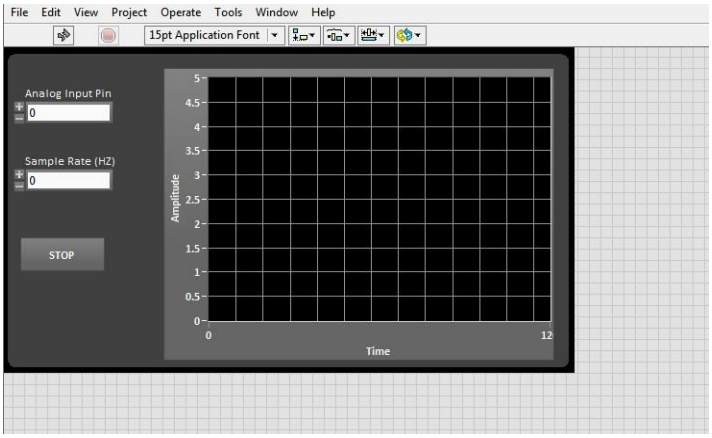


Fig -6: LabVIEW Front Pannel CRO



5. A Top 5 reasons LabVIEW makes us more productive while using AVR Microcontroller

1. Interact with your system through a graphical user interface.
2. Streamline your design process with intuitive graphical programming.
3. Improve your debugging experience with interactive tools.
4. Leverage built in resources/functions for implementing simple to complex tasks.
5. Open API (Application Programming Interface) allows for complete customization

6. SOFTWARE SETUP

1. With AVR board ready, make sure you have LabVIEW 2013 or newer version installed.
2. Install NI-VISA Drivers.
3. Install the AVR IDE and drivers for Windows.
4. Install the LIFA Toolkit using NIMAX.
5. Upload the sketch 'LIFA_Base.pde' to the AVR Microcontroller and we are done with the setup.

7. Lab Setup:

- To demonstrate the potential applications of the AVR based Data Acquisition and Control using LabVIEW a simple lab setup is built as shown in the fig.1. AVR BOARD with Atmel-328 8-Bit microcontroller is used.
- To demonstrate the sensorial data collection ability a photocell (Light Dependant Resistor) is used and also Infrared based RPM measurement is demonstrated.
- Analog sensor is replaced by a Variable Potentiometer.

To demonstrate the control ability a standalone DC motor controller using PWM (Pulse Width Modulation) is built using LabVIEW GUI code, AVR and L293D motor driver IC.[4]

Fig -7: LabVIEW output on CRO Program.

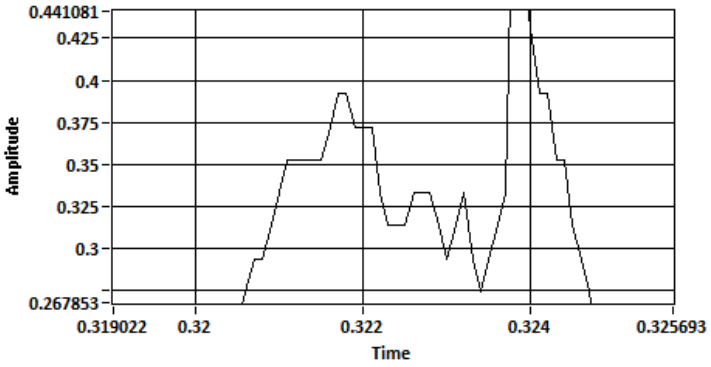


Fig -8: LabVIEW output on DAQ Program.

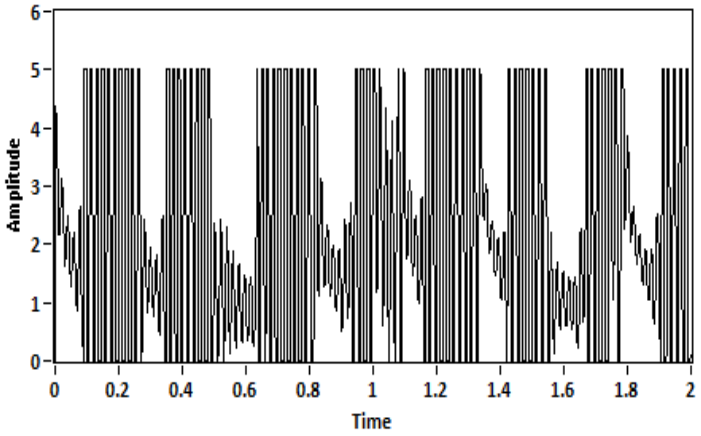
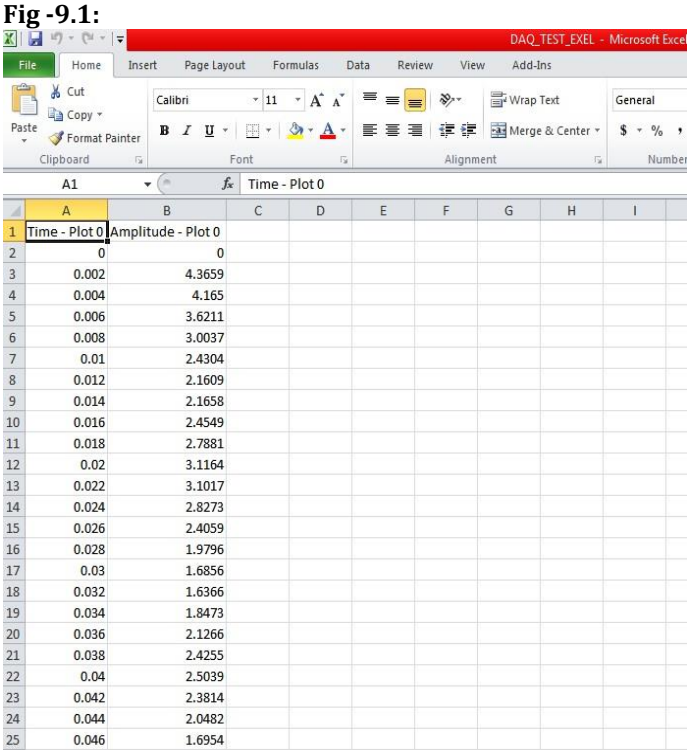


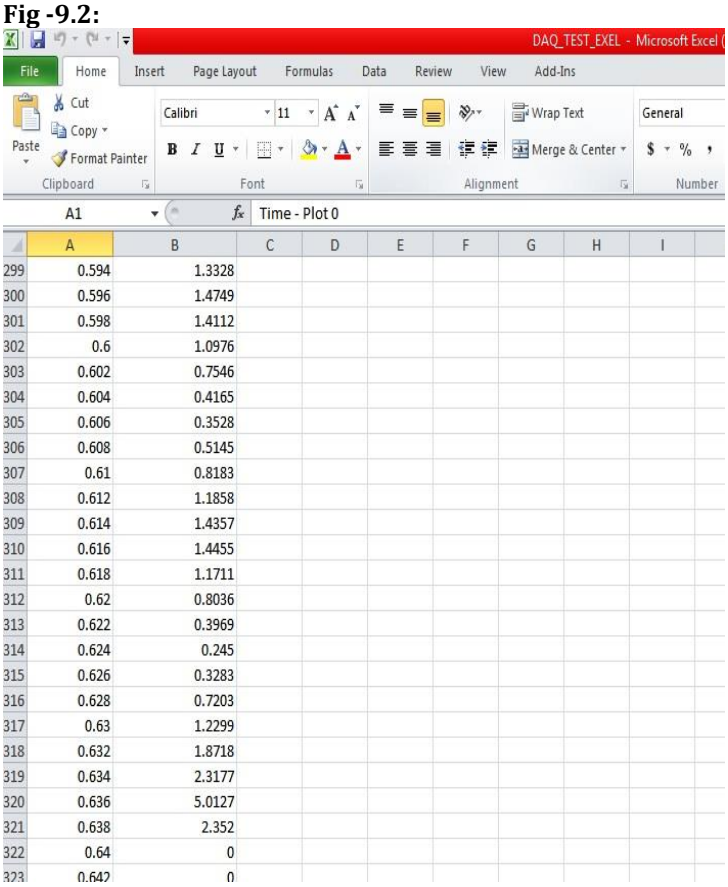
Fig -9: LabVIEW output, readings recorded on MS-Excel.

Fig -9.1:



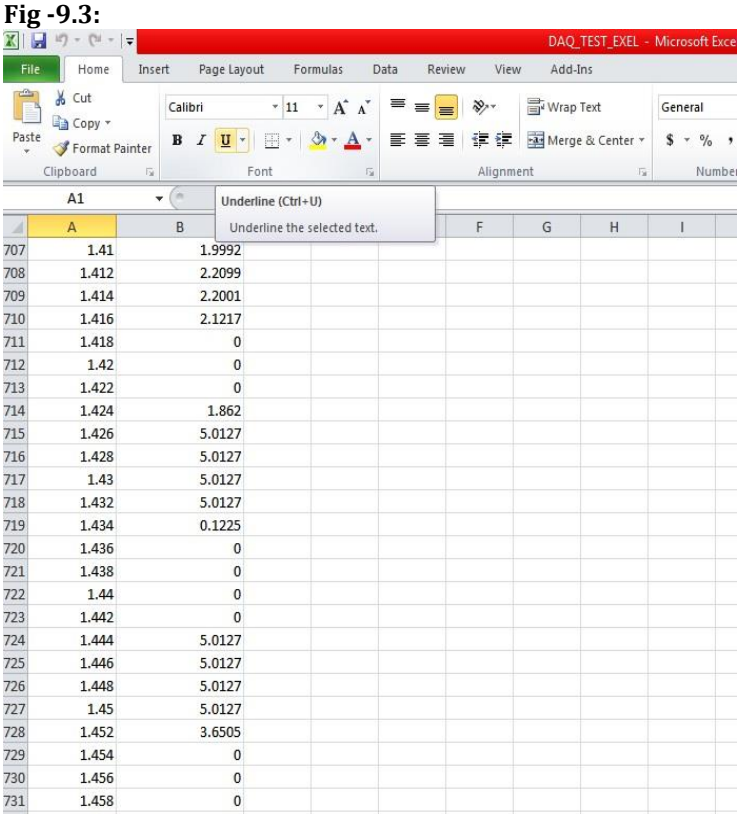
	A	B
1	Time - Plot 0	Amplitude - Plot 0
2	0	0
3	0.002	4.3659
4	0.004	4.165
5	0.006	3.6211
6	0.008	3.0037
7	0.01	2.4304
8	0.012	2.1609
9	0.014	2.1658
10	0.016	2.4549
11	0.018	2.7881
12	0.02	3.1164
13	0.022	3.1017
14	0.024	2.8273
15	0.026	2.4059
16	0.028	1.9796
17	0.03	1.6856
18	0.032	1.6366
19	0.034	1.8473
20	0.036	2.1266
21	0.038	2.4255
22	0.04	2.5039
23	0.042	2.3814
24	0.044	2.0482
25	0.046	1.6954

Fig -9.2:



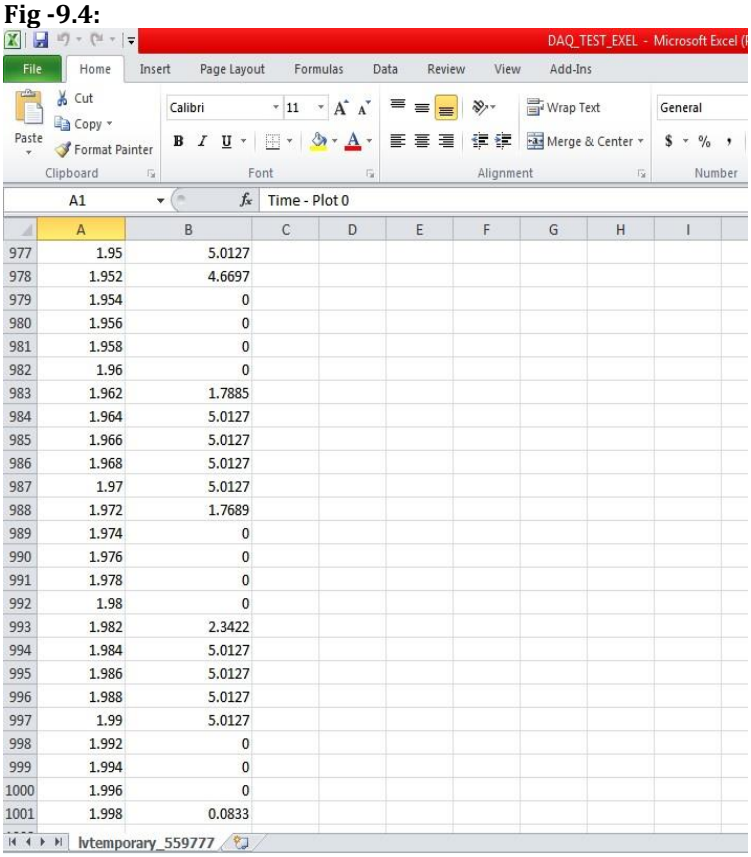
	A	B
299	0.594	1.3328
300	0.596	1.4749
301	0.598	1.4112
302	0.6	1.0976
303	0.602	0.7546
304	0.604	0.4165
305	0.606	0.3528
306	0.608	0.5145
307	0.61	0.8183
308	0.612	1.1858
309	0.614	1.4357
310	0.616	1.4455
311	0.618	1.1711
312	0.62	0.8036
313	0.622	0.3969
314	0.624	0.245
315	0.626	0.3283
316	0.628	0.7203
317	0.63	1.2299
318	0.632	1.8718
319	0.634	2.3177
320	0.636	5.0127
321	0.638	2.352
322	0.64	0
323	0.642	0

Fig -9.3:



	A	B
707	1.41	1.9992
708	1.412	2.2099
709	1.414	2.2001
710	1.416	2.1217
711	1.418	0
712	1.42	0
713	1.422	0
714	1.424	1.862
715	1.426	5.0127
716	1.428	5.0127
717	1.43	5.0127
718	1.432	5.0127
719	1.434	0.1225
720	1.436	0
721	1.438	0
722	1.44	0
723	1.442	0
724	1.444	5.0127
725	1.446	5.0127
726	1.448	5.0127
727	1.45	5.0127
728	1.452	3.6505
729	1.454	0
730	1.456	0
731	1.458	0

Fig -9.4:



	A	B
977	1.95	5.0127
978	1.952	4.6697
979	1.954	0
980	1.956	0
981	1.958	0
982	1.96	0
983	1.962	1.7885
984	1.964	5.0127
985	1.966	5.0127
986	1.968	5.0127
987	1.97	5.0127
988	1.972	1.7689
989	1.974	0
990	1.976	0
991	1.978	0
992	1.98	0
993	1.982	2.3422
994	1.984	5.0127
995	1.986	5.0127
996	1.988	5.0127
997	1.99	5.0127
998	1.992	0
999	1.994	0
1000	1.996	0
1001	1.998	0.0833

8. AVR FAMILY PLATFORM

AVR family board is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

AVR family can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the AVR family programming language (based on Wiring) and the AVR family development environment (based on Processing). AVR family projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing, Max MSP).

The boards can build by hand or purchased preassembled; the software can be downloaded for free. The hardware reference designs (CAD files) are available under an open-source license, you are free to adapt them to your needs.

The AVR family integrated development environment (IDE) is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. A program or code written for AVR family is called a "sketch". AVR family programs are written in C or C++. The AVR family IDE comes with a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier. Users only need define two functions to make a unable cyclic executive program.[6]

9. ADVANTAGES

- **Low cost: -** Because the hardware required is low cost and general user license potential applications is limited to the user.
- **Easy to assemble.**
- **Able to run on different formats.**
- **Open hardware and open software.**
- **Anyone can use it and improve it.**
- **Bidirectional**: It is possible for data to be transmitted in both directions via USB serial communication.

10. APPLICATIONS

- **In educational institutions:** this apparatus can be modified to function as a Remote Virtual Lab.
- **Small scale industries:** can employ this method of control if accuracy and speed is of less importance (since AVR family microcontroller has certain limitations over speed i.e. clock frequency).
- **In a large scale farming:** for collecting data from hundreds of sensors like temperature and humidity sensors and then taking collective decision over a period of time for control action like sprinkler operation, can be implemented effectively and economically using AVR family and LabVIEW.
- Main application of this system is study the various signal in detail.

11. LIMITATIONS

- Not able to get good results for signals above 10,000 Hz. As sampling Rate is limited.
- For Industrial Applications LabVIEW Require License Version which is costly.

12. CONCLUSION

A cost effective means of employing powerful programming tool for various applications using prototyping board AVR is developed. The potential of this method will be extended for various other engineering applications in the near future.

ACKNOWLEDGEMENT

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