INTEGRATION OF PARAMETRIC ANALYSIS USING EMBEDDED SYSTEMS WITH STATE MACHINE CONCEPT

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***Abstract*— Measurements play a vital role in the precision of an object. It helps to quantify the physical properties. Multiple physical components are required to measure the various dimensions of an object. Involvement of manpower is more in the case of traditional methods. Hence there is a need for an automated measurement. The precision of measurement is low and the system is not portable when an ultrasonic sensor or IR sensor is used. In this project, an E-Scale is constructed using a laser sensor, encoder, Gyroscope and gyroscope, controlled by a microcontroller and output is displayed using an OLED display. This E-scale is used to calculate the distance between user and an object and between objects, angle between the two planes, length and height of an object, area of square and rectangular objects, circumference and area of the circular objects, volume of cylindrical and cubical objects. Thus E-scale ensures easier and more precise measurement of objects than the conventional means of measurement.**

Keywords: Atmega 328p, OLED, Rotary Encoder, Gyroscope, Laser Sensor, Measurements.

I. INTRODUCTION

Measurement is the count of how many units are needed to fill, cover, or match the attribute of an object(such as length, width, volume, weight, area) being measured. Earlier measurements were made in terms of dimensions of body. Measurements were never exact and will always contain errors. The main objective of a measuring device is to measure the proper dimensions. Measuring devices plays a vital role in the industries, factories and so on. It is a tedious process for using the devices separately for particular purposes. It replaces the purpose of multiple devices used for a single dimension measurement, which reduces the human wok and time taken for the measurement. Implementation of area and volume measurements are also made possible with the simultaneous collection of data by various sensors. Handling of tool is easier in case of electronic gadgets which is handy to use. So, the idea is to integrate the basic measuring devices into a single compact device.

II. ALGORITHM USED

Handling the measuring devices separately for each and every parameters will consume time higher than the calculated. So, integrating all the devices into one is the right way to do so. The main objective of this prototype is to measure Angle, Distance, Height, Area and Volume. ATmega328p gathers the data from the particular modules and integrates them together. Laser Sensor passes a reflecting beam and gains the distance travelled through a particular point with the help of the time taken, Gyroscope gathers different angles based on various deviations. Additionally Rotary encoder is placed on the rear side of the device to measure short areas. It will be helpful for minute measurements. Finally, OLED display gathers the data from every module interfaced with it and displays the numbers based on the user's need.

A. Inter-Integrated Circuit:

The Inter-integrated Circuit (I2C) Protocol is a protocol which is intended to allow multiple "slave" digital integrated circuits to communicate with one or more master chips. Like the Serial Peripheral Interface (SPI),it is only intended for short distance communications within a single device. Like Asynchronous Serial Interfaces (such as RS-232 or UARTs), it only requires two signal wires to exchange information.

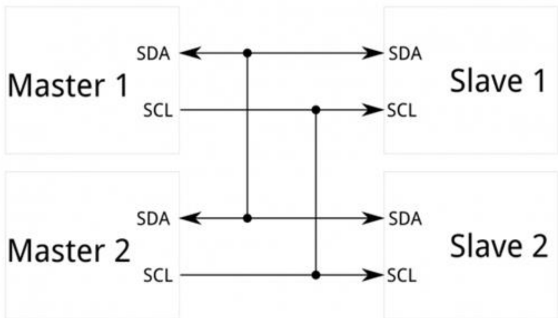

Fig. 2.1 Image showing the Master Slave concept

So, the communication is done by using the I2C protocol for all the modules interfaced here. The devices that are connected to the I2C bus are categorized as master or slaves. All the devices respond to instructions from this master device are considered as slaves. When the master device wants to send data to or from a slave device, it specifies the particular slave address on the SDA line and then it starts proceeding with the transfer. So, there will be an effective communication between the master and a particular slave device. All the other slave devices does not respond until their address is specified to the SDA line by the master. They will remain idle. Some important features of I2C protocol are that it requires only two common bus lines are required to control any device over its network, No need of any prior agreement on the data transfers like that it requires in UART communication. So, the data transfer rate can be adjusted whenever it is required by the user, It only has simple mechanism for validation of data that has been transferred, Specifically it uses seven bit address system to target the appropriate device on the I2C bus, The network of I2C is one of the easiest ones to scale. So, whenever any new devices are ready, they can be easily connected to the two common bus lines. Data loss is considerably less when compared to the shorter ranged protocols. Thus, preferring I2C protocol is better for short range communications rather than choosing tedious protocols.

B. Finite State machine:

A **finite state machine** (sometimes called a finite state automaton) is a computation model that can be implemented with hardware or software and can be used to simulate sequential logic and some computer programs. A finite state machine is a model of discrete behavior, which consists of: a finite number of states transitions between two of those states, and actions. A state represents a certain behavior. A transition indicates a state change and is guarded by a condition. An action is a description of an activity that is to be performed. If this action depends on the state, it's called a Moore machine. If the action is performed when a transition occurs, so when the state and condition are satisfied, it's called a Mealy machine. Most machines are both a Moore and Mealy machine at the same time. Some integrated development environments (IDE) allow a designer to draw a FSM diagram on screen, and then the IDE automatically translates the diagram into a software or FPGA or ASIC implementation. This allows the designer to use a natural way of representation of the system. A finite state machine is used to execute the logic sequentially so that any unnecessary misbehavior is avoided in handling the device.

III. Hardware System Design

The following are the hardware structures that are used in the proposed system:

- ATmega 328p Integrated Chip
- Gyroscope Sensor Module
- Laser Sensor Module
- OLED Display
- Rotary Encoder
- Printed Circuit Board

The synchronous functioning of all these hardware components can enhance the measurement and accuracy. The important reason behind the motive is, in this fast moving world everything needs to be as fast as it can.

A. ATmega 328p:

It is basically an Advanced Virtual RISC (AVR) micro-controller. It supports the data upto 8 bits . It contains total of 32 pins and have 32KB of built-in memory, 1KB of Electrically Erasable Programmable Read Only Memory, 2KB of Static Random Access Memory. Operating Voltage is ranging from 3.3V to 5.5V. It has 8 pins for ADC operations, which all combines to form Port A (PA0 – PA7) .This IC completely holds the major part of this innovation. It gathers the output of the every module interfaced with it and provides it as an integrated set of digital output though the display.

B. Gyroscope sensor module:

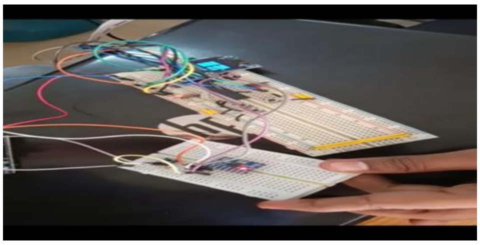

Fig. 3.1 Image of handling gyroscope sensor

It is a device that can measure and maintain the orientation and angular velocity of the objects. These can able to measure the position of tilt and lateral orientation of the objects whereas an accelerometer can only able to measure the linear motion of an object. When compared to accelerometers, Gyroscope sensors are more advanced and superior. It is also called as angular rate sensors (or) angular velocity sensors. It is measured in degrees per second and angular velocity is the change in the rotational angle of the object per unit time. It is used in the areas like car navigation systems, digital cameras and robotic systems.

C. Laser Sensor Module:

Fig. 3.2 Image of Laser sensor module

It is a device used to detect smaller objects around it and also can be used to detect accurate positions. It has light waves of smaller wavelength and it only travels in the parallel direction. If someone looks directly into the light when it is in the ON state, it can cause some serious eye problems. The laser emitter transmits visible laser light through a lens, towards a target or an object and it gets reflected diffusely from the surface of the target, where a receiver lens from the sensor waits for the reflected light and measures the distance through the time taken to reach the receiver.

D. OLED Display:

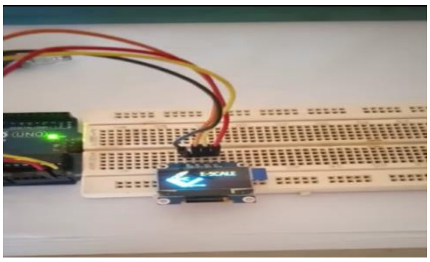

Fig. 3.3 Image of a OLED display working

OLED (Organic Light Emitting Diodes) is said to be an flat light emitting technology. It is constructed by placing a series of thin films between two conductors. They are emissive displays and does not require a back-light and so are thinner and more efficient than LCD displays. Here, the resolution is 128x64 and it is mainly used for user interface and to monitor the measurement output.

E. Rotary Encoder:

It is also called as shaft encoders which is an electro-mechanical device which has the capability to convert the motion of as shaft or angular position to analog or digital outputs. They are used in wide range of applications and therefore in our prototype it is used for measuring minute measurements by rolling the shaft to some particular distance and the travelled distance can be measured by number of shaft rotations. The output of the distance travelled can be monitored in the OLED display

F. Printed Circuit Board:

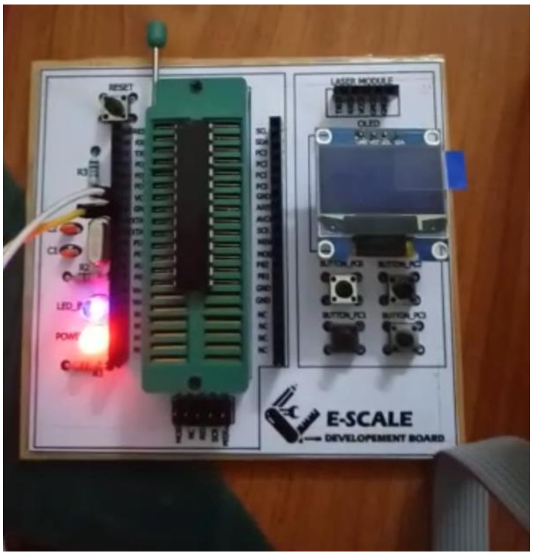

Fig. 3.5 Development Board

The prototype can be developed into a compact device only by integrating everything onto a PCB. Thus a compact measuring device for measuring the distance, height, area, volume can be measured using this device.

IV: Flow Diagram Of Module Interface

In this method the measurements can be achieved by gathering all the data from each and every modules separately and integrating them together into ATmega 328p and it has the capability to process them together.

The flow diagram represents every modules that are interfaced with the IC and it is shown below:

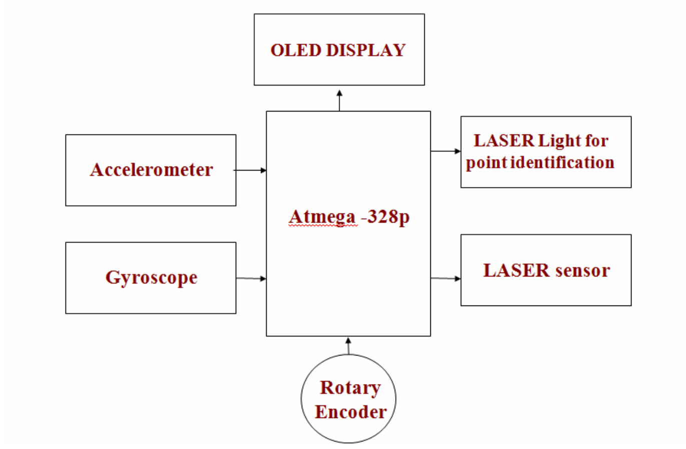

Fig. 4.1: Block showing the modules altogether

Atmega-328p acts as the one which holds everything together. Gyroscope and accelerometer will provide the data for angular motion and linear motion to the specified Atmega-328p IC. Rotary Encoder which is placed in the rear side of the prototype helps to find out the tiny measurements which can't be measured by other devices by using its shaft rotating on the surface. Number of shaft rotations is converted into the distance travelled and it pushes its data to the IC. Similarly, Laser sensor emits its light waves to a particular object and it can only able to travel to a particular distance based on its design and it can measure the distance upto that area by reflecting the light beam back to the receiver and the time travelled to reach the distance is converted into appropriate numbers.

Finally, each and every module's output can be monitored via OLED display based on the user's choice.

IV. Conclusion And Future Scope

The future scope of this project is to develop a decent user interface and give the part of control to the user via applications. The future is towards development and co- organization and the scope for this project in measurements is quite larger and serves as a better ground work for further enhancement in the area. In partnership with ventures promoting the ideas and proposed models the prototype can be implemented into real time product real soon.

V. Acknowledgment

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