International Journal of
Advances in Scientific Research and Engineering (ijasre)

E-ISSN : 2454-8006

Vol. 3. Special Issue 8, August-2017

Motion Modeling of Virtual Reality Welding

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ABSTRACT

The vital role of motion modelling in virtual reality system is to facilitate the user's description of motion and to enable the user to have precise motion control at real time interactive simulation. In a real environment motion characteristic is based on sensors and servomechanisms where as in virtual reality systems the motion fundamentals are kinematic in nature. To achieve physically correct interactivity suitable dynamic constraints, should be imposed which can be obtained by augmented reality interface. Beyond input and output hardware, the underlying software plays a very important role in virtual reality systems. It is responsible for the managing of input/output devices, analyzing incoming data and generating proper feedback. This research paper focusses on motion modelling for interaction between CAD model and Virtual Reality Model using softwares such as 3ds Max 2017 and Unity 3d. The paper also describes various hardware configuration such as sensors and Arduino for virtual reality welding.

Keywords: *Virtual Reality, 3ds Max 2017, Unity 3d, Motion modelling, Arduino*

1. INTRODUCTION

a. Virtual Reality

Virtual Manufacturing technique is a virtual reality technology to create virtual environment on the computer screen to simulate the physical world. The expertise and knowledge base gained from the work in the virtual environment enables the user to apply more meaningfully in the real-life situation. Banerjee has worked in Graphical User Interface, Virtual Reality technologies, auto interpretation [1].

2. LITERATURE SURVEY

G M Balyliss emphasis on model generation in virtual environment using VR techniques with better 3D visualization of an object and explained theoretical solid modeling techniques using Virtual Reality Modeling Language (VRML) and 3D Max [2]. Bharath et al developed different parts of virtual welding platform and animated the flow of welding using VR tools [3]. Leo Louis studied the working principle of Arduino, its hardware/software features and its advantages of building new devices of our own to create and implement innovative products to global market [4]. Allen R. Mendes explained Arduino Mega 2560 is used for various types of application such as laser cutting, CNC and 3D Printing [5]. Deepak D has emphasis the importance of Arduino and its interactivity between machine and software in 3D Printer [6].

3. METHODOLOGY

Motion modelling of virtual reality welding involves parameters such as modelling, simulation and integrity between virtual model and realistic model.

b. Methodology of modelling and simulation

3D modelling of virtual welding using 3DS Max software illustrates modelling of an entire virtual welding platform, simulation of a welding in virtual mode, algorithm.

c. Methodology of motion modelling

Unity 3d software is a game engine which illustrates the simulation of an entire model in a game mode and integrates model between virtual and real environment. Arduino is a microcontroller which integrates several sensors to a game engine by serial communication coding. Fig 1 illustrates the methodology of Virtual Reality Welding.

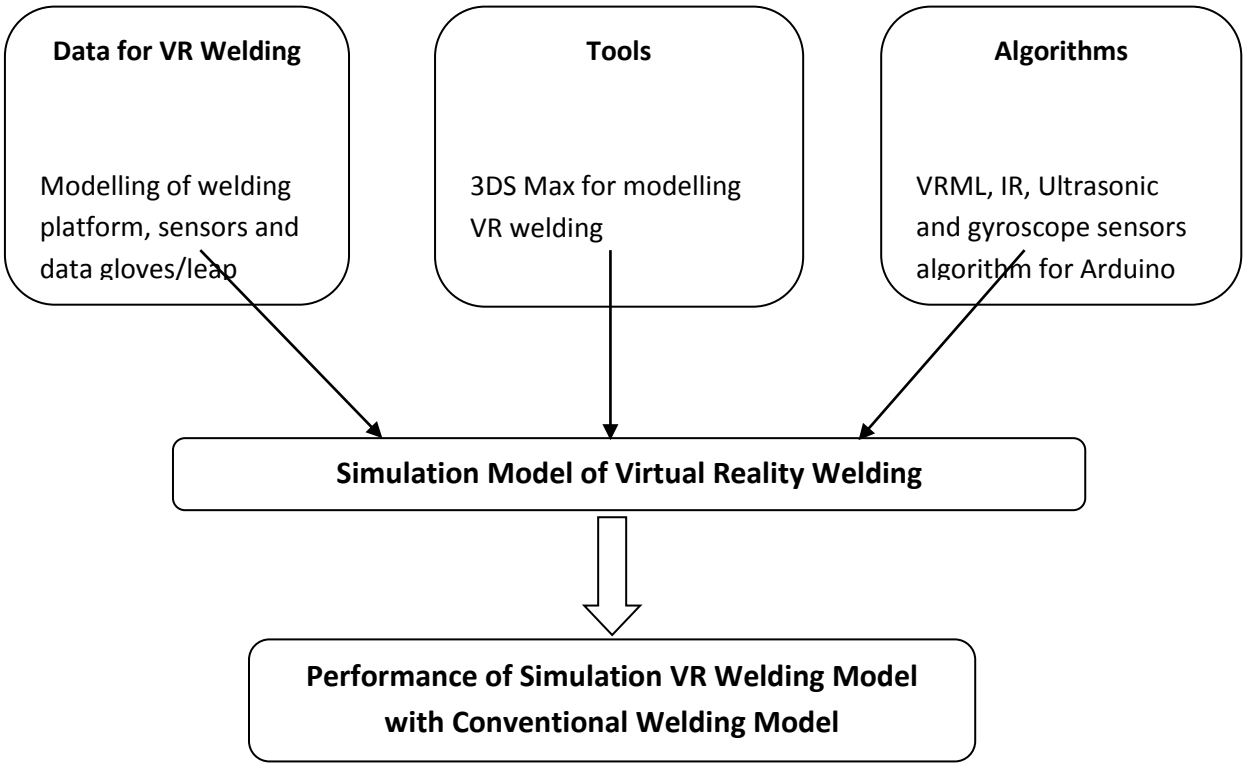


Fig 1: Methodology of Virtual Reality Welding

3. Design

3.1 Arduino Mega 2560

The Arduino Mega 2560 is a microcontroller which has 54 digital input/output pins, 16 analog inputs, 4 Universal Asynchronous Receiver-Transmitter (UART) hardware serial ports for Transistor Transistor Logic (TTL)

International Journal of
Advances in Scientific Research and Engineering (ijasre)

E-ISSN : 2454-8006

Vol. 3. Special Issue 8, August-2017

(5V) serial communication, a 16 MHz crystal oscillator, a Universal Serial Bus (USB) connection, a power jack, an In-Circuit Serial Programming (ICSP) header, and a reset button. It simply connects to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino. Fig 2a shows the plan of Arduino Mega 2560 with key labelling and Fig 2b gives a detailed technical drawing of Arduino Mega 2560 designed using Solidedge ST9 software.

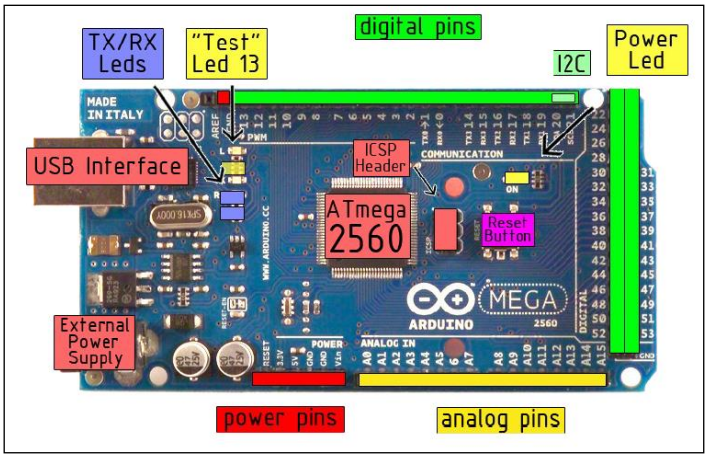


Fig 2a: Top view of Arduino Mega 2560

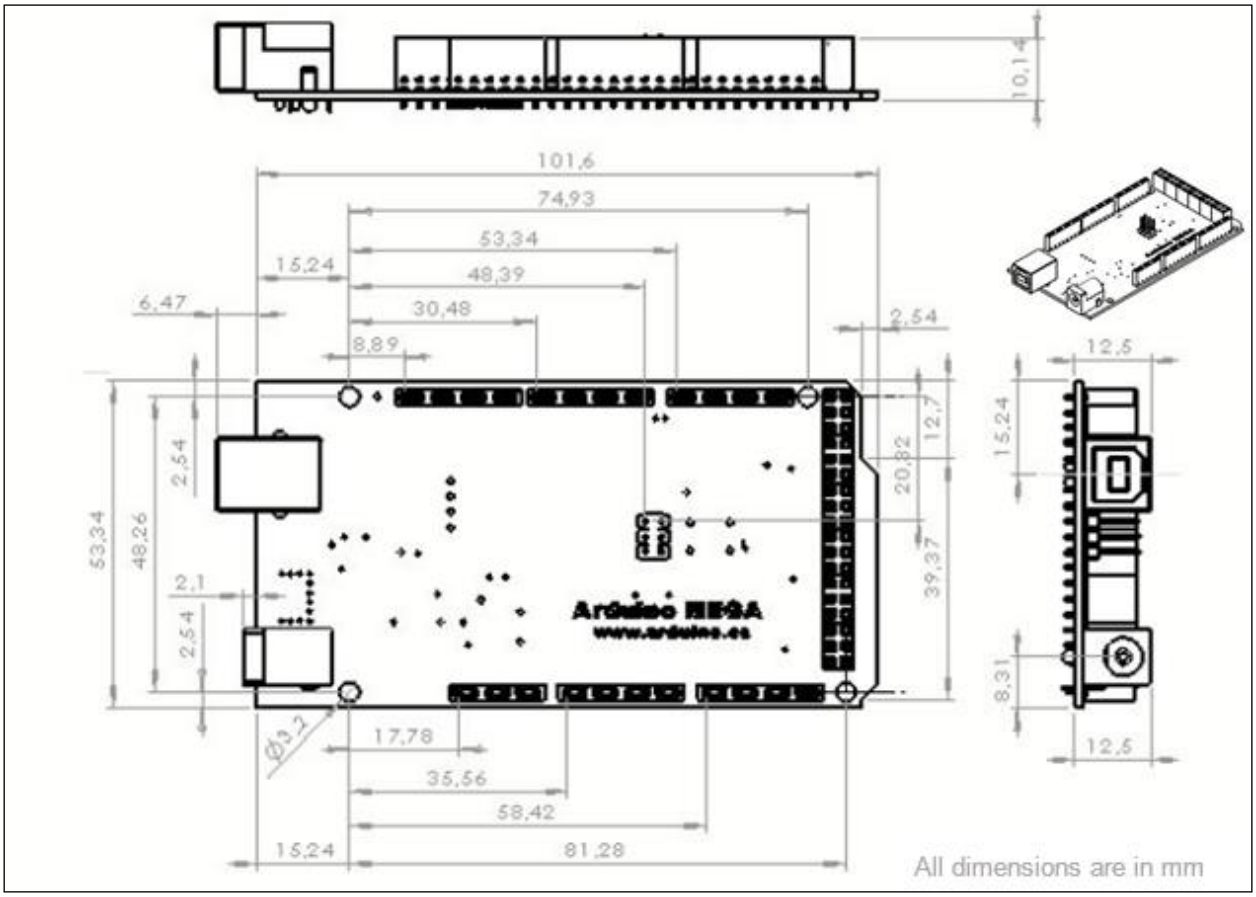
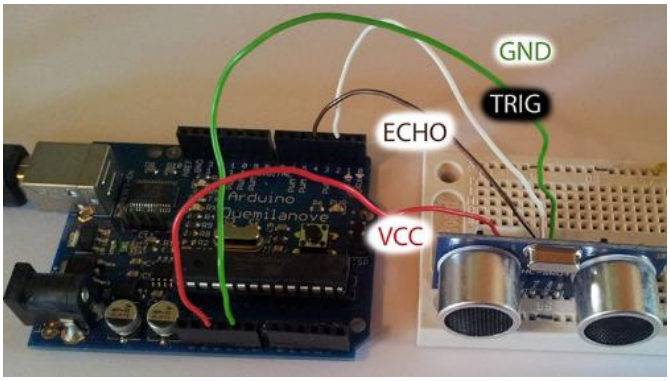


Fig 2b: Technical Drawing of Arduino Mega 2650

International Journal of
Advances in Scientific Research and Engineering (ijasre)
E-ISSN : 2454-8006
Vol.3, Special Issue 1 Aug - 2017

3.2 Sensors and its coding for interactivity

Ultrasonic sensor emits an ultrasound at 40,000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module [7, 8]. Calculation of the distance is obtained by considering the travel time and the speed of the sound. Ultrasonic sensor is used in virtual welding to measure the distance of an electrode movement from one end to other end of the workpiece [9,10]. Fig 3 shows ultrasonic sensor and its coding for interactivity between Arduino and virtual electrode. The MPU-6050 devices combine a 3-axis gyroscope and a 3-axis accelerometer on the same silicon die, together with an onboard Digital Motion Processor (DMP), which processes complex 6-axis Motion Fusion algorithms. These Motion Tracking devices are designed for measuring angle movement of an electrode. Fig 4 shows the representation of MPU 6050 sensor with coding.




```
const int trigPin = 9;
const int echoPin = 10;
long duration;
int distance;
void setup()
.
void loop()
{
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
```

Fig 3: Ultrasonic sensor and its coding

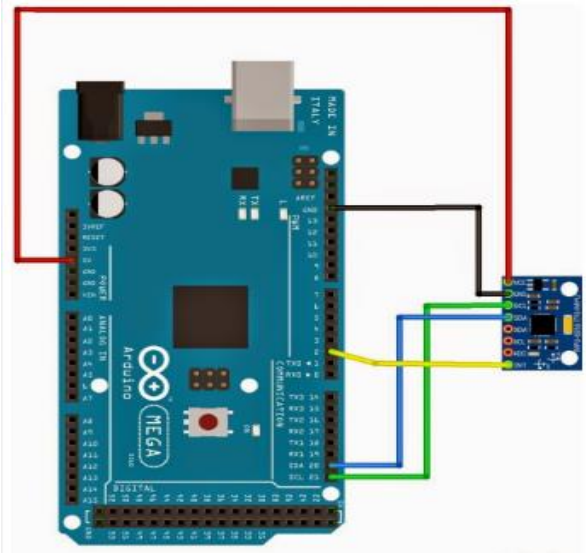


Fig 4: MPU 6050 gyroscope sensor and its coding

```
#include <ADXL345.h>
#include <HMC58X3.h>
#include <MS561101BA.h>
#include <MPU60X0.h>
#include <EEPROM.h>
//#define DEBUG
#include "DebugUtils.h"
#include "CommunicationUtils.h"
#include "FreeIMU.h"
#include <Wire.h>
#include <SPI.h>
int raw_values[9];
//char str[512];
float ypr[3];
float val[9];
FreeIMU my3IMU = FreeIMU();
void setup()
{
  Serial.begin(115200);
  Wire.begin();
  delay(5);
  my3IMU.init();
  delay(5);
}
void loop()
{
my3IMU.getYawPitchRoll(ypr);
 Serial.print("Yaw: ");
 Serial.print(ypr[0]);
 Serial.print(" Pitch: ");
 Serial.print(ypr[1]);
 Serial.print(" Roll: ");
 Serial.print(ypr[2]);
 Serial.println("");
 delay(10);
 }
```

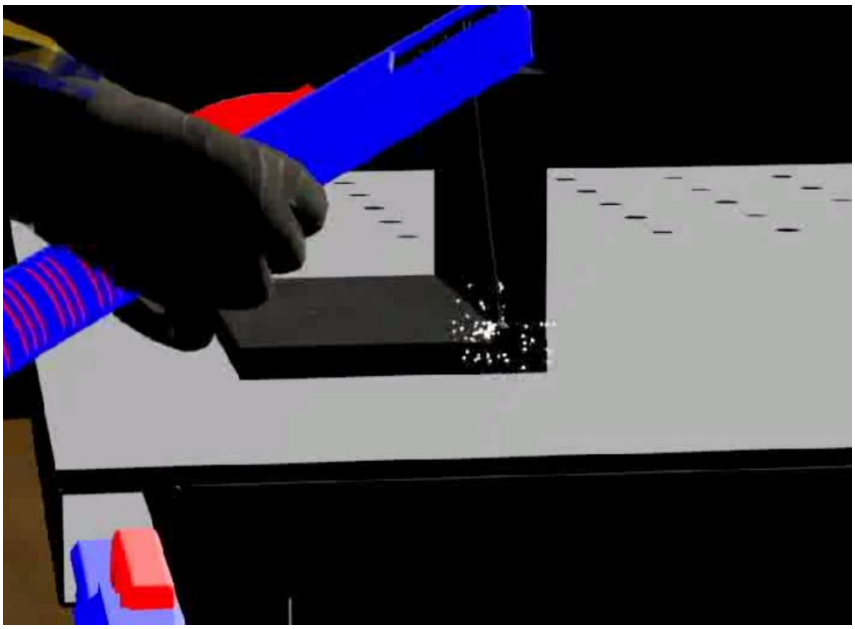


Fig 5: Virtual welding simulation model

4. CONCLUSIONS

A graphic user friendly software package has been developed that can tackle the problem of welding platform design and subsequent visualization of simulation of arc welding in a virtual environment. All the models are developed in 3D environment. Other features like camera views, VRML scripts, serial communication coding etc. are incorporated for better understanding for a user. In this research work motion modelling of virtual welding is developed and generated Arduino Mega code for ultrasonic and MPU sensors to interact between virtual and real environments.

Acknowledgement

The authors thank Mr. Prashanth S N, student of Atria Institute of Technology for his support on analyzing and suggesting inputs in Arduino Mega 2650.

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