COMMUNICATION AND CONTROL IN INTERNET OF THINGS

Team – 6: Star Wires

Downhill Race/Roller Coaster – Conservation of Energy

Link: https://www.youtube.com/watch?v=2XSUyM7fXYY&feature=youtu.be

TEAM MEMBERS:

1. SREENYA CHITLURI – 2020102065
2. SRUJANA VANKA – 2020102005
3. SMRUTI BISWAL – 2020112011
4. ROHAN MADINENI - 2020102066
5. SIDDHANT GARG - 2020112006

PROBLEM STATEMENT

- The objective of this project is to prove the law of conservation of energy.
- **Law of conservation of energy:** Energy can neither be created nor be destroyed, it can only be converted from one form to another.
- In this project, we are expected to build a setup where the kinetic and potential energies of a moving object are measured at various heights. After, doing so, we see how the total energy varies at these discrete points.

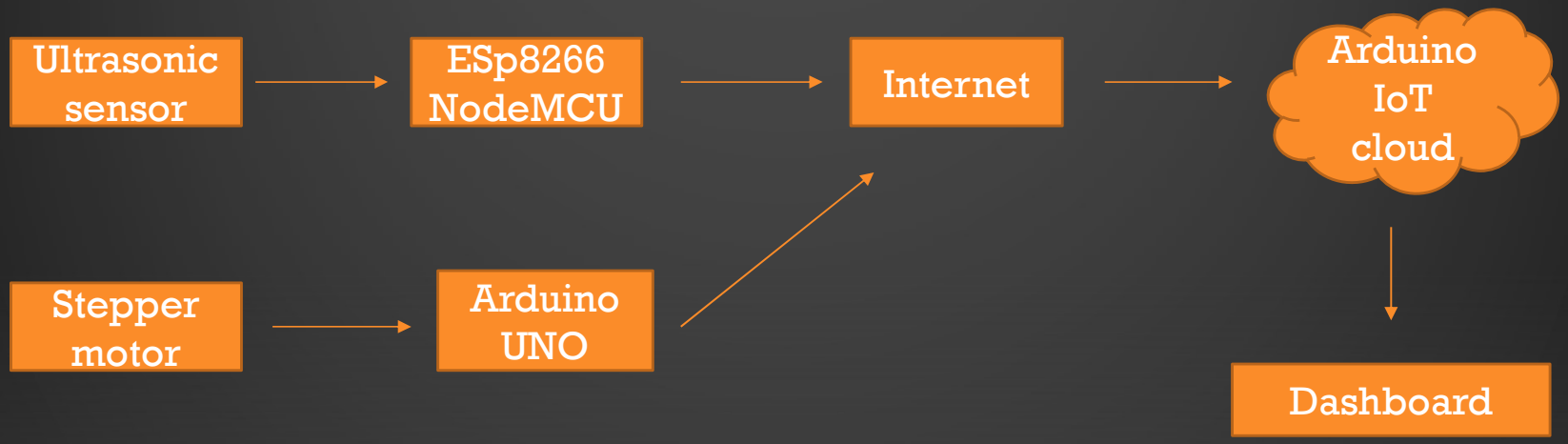
DETAILS OF EXPERIMENT WITHOUT IOT

- Energy is conserved in theory.
- As an object loses potential energy, it should theoretically gain an equal amount of kinetic energy.
- Thus as the object rolls down an inclined plane it gains speed.
- This exchange of energy should theoretically follow the condition:

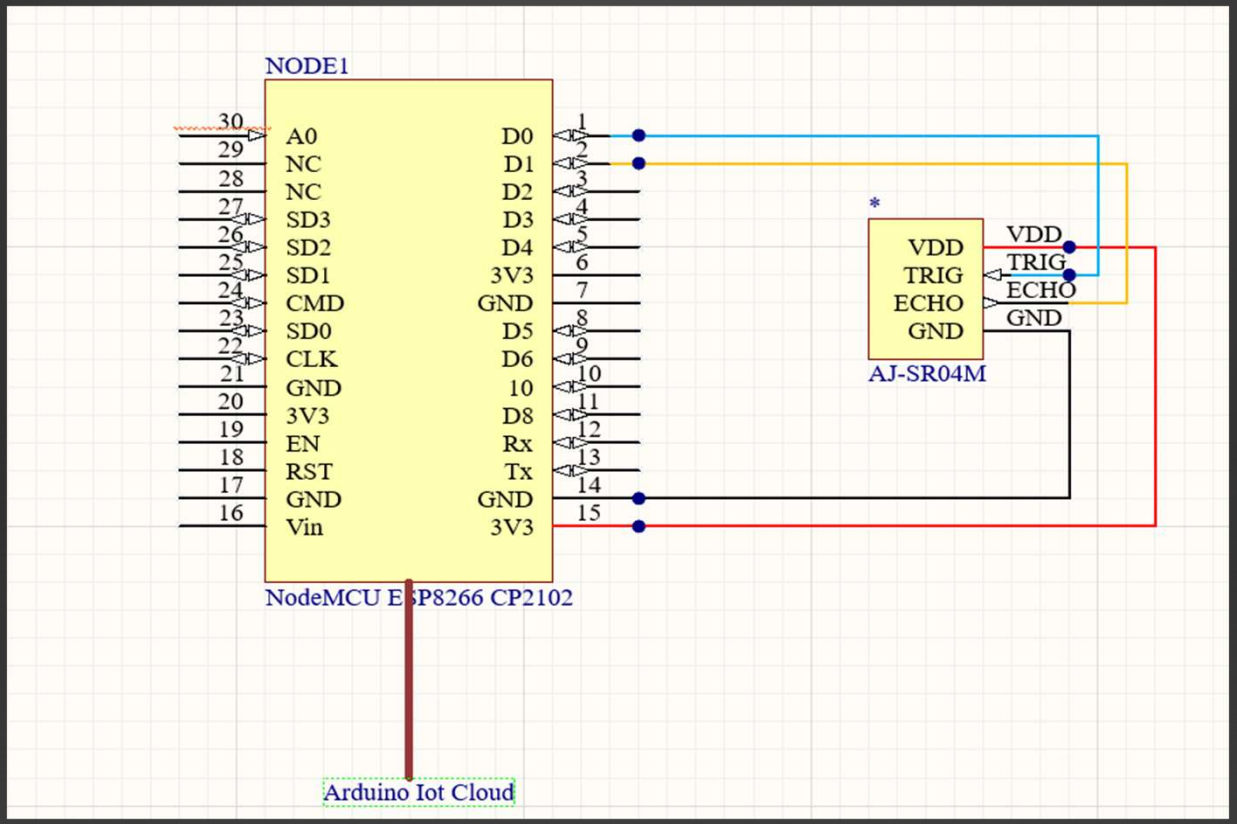
$$mgh + 1/2mV^2 = \text{constant}$$

- Thus we will record the height and speed of an object on an inclined plane at various points and verify the conservation of energy.

BLOCK DIAGRAM OF IOT SETUP



CIRCUIT DIAGRAM



$V = \Delta s/0.3$
Height = s*sin(Θ), Θ = 30
Energy = $\frac{1}{2}mv^2 + mgh$

FLOWCHART OF CODE

Ultrasonic sensor senses the distance of object every 0.3 seconds

When the distance sensor becomes zero on the left side, clockwise conveyor belt motor is triggered.

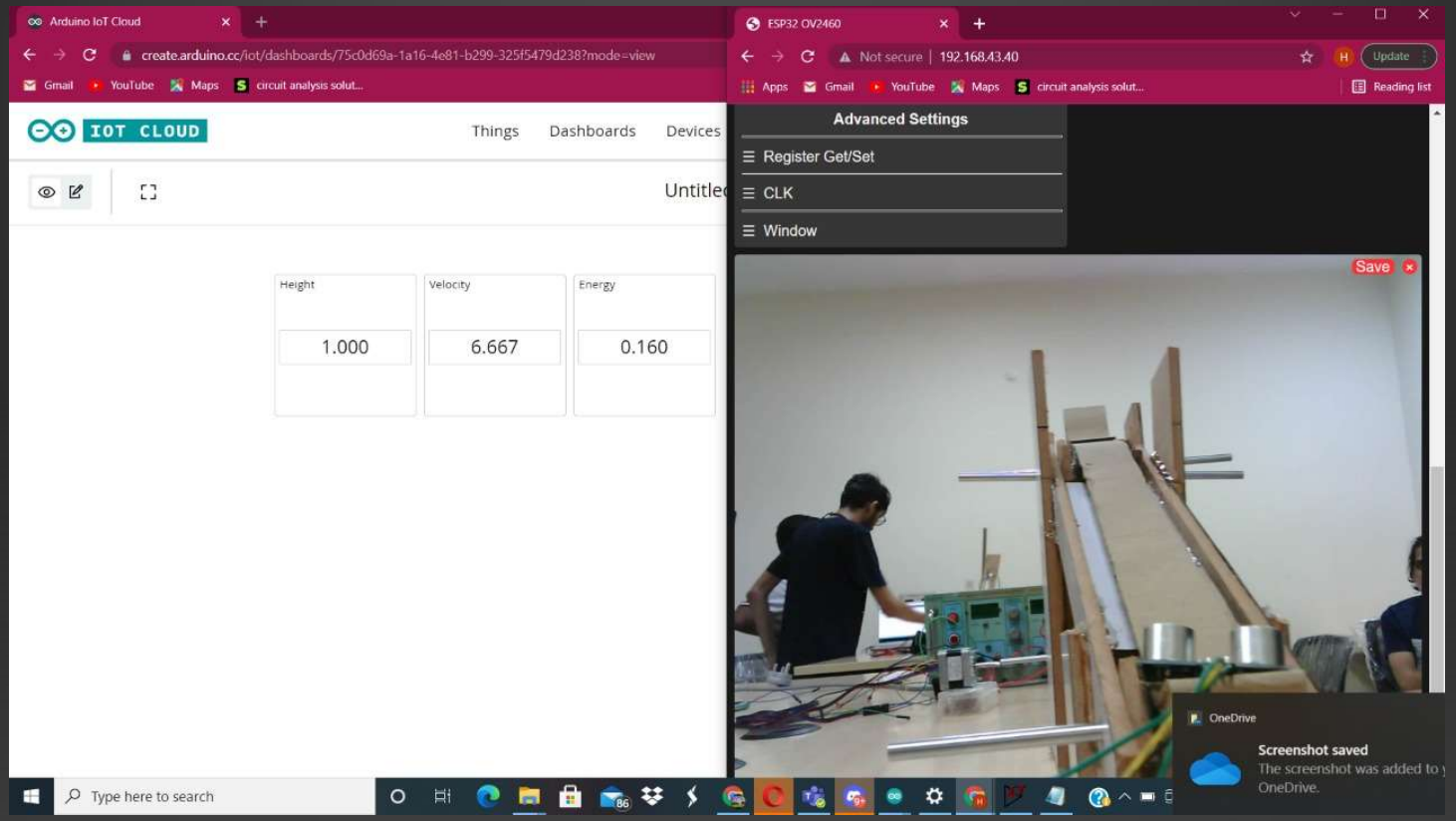
The object is lifted up the left ramp by conveyor belt.

The conveyor belt stops when the object reaches the top of the left ramp.

The object now falls down freely on the right ramp, its distance is again sensed by the right side distance sensor

Again when the distance sensor becomes zero, the motor of conveyor belt is triggered, but this time in anticlockwise direction. And the loop continues.

DASHBOARD


Arduino IoT Cloud
create.arduino.cc/iot/dashboards/75c0d69a-1a16-4e81-b299-325f5479d238?mode=view
Gmail
YouTube
Maps
circuit analysis solut...
IOT CLOUD
Things
Dashboards
Devices
Untitle
Height
1.000
Velocity
6.667
Energy
0.160
ESP32 OV2460
Not secure | 192.168.43.40
Update
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circuit analysis solut...
Reading list
Advanced Settings
Register Get/Set
CLK
Window
Save
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OneDrive.
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ATTEMPT 1 OF EXPERIMENT

- In this attempt, we wanted to measure the velocity (for the kinetic energy), through an accelerometer. We assumed a very small duration of time where there is a constant acceleration. Multiplying the measured acceleration with time would give us velocity in that region.
- For measuring potential energy, ultrasonic sensors (HC-SR04) were used to measure the height from the reference level (base of the whole setup) at fixed discrete points.
- We wanted to build the setup such that the height sensors would measure the height only when triggered by the moving object near them so that they don't burn out.

REASON FOR REJECTION OF THE ABOVE IDEA

- Rigidity of wheels due to gears when motor is in off-state
- Car would immediately revert to rest state after motor was switched off
- The time of motion isn't enough to demonstrate conservation of energy as all mechanical energy is immediately dissipated as heat and sound
- Possible causes involves friction caused by wheels, gears and tracks

FINAL PLAN

- A marble/object is sent up an inclined plane and allowed to roll down a second inclined plane.
- The height of the marble is observed at different points of the inclined plane while it's in downward motion.
- The speed of the marble is observed at different points of the inclined plane while it's in downward motion.
- The marble is then forced back up the inclined plane and rolled down the first.
- The potential and kinetic energy at different points of the experiment is observed and its conservation can be demonstrated.

IMPLEMENTATION

- Our project has been implemented using conveyor belts.
- A motor rotates the conveyor belt which is stretched over and around an inclined plane in order to send the object up it with the help of a protrusion.
- At the height of the plane this object tips over the edge to a second conveyor belt and rolls down it while its speed and height is observed
- Since the belt is fixed, we already know the different heights at which we want the heights in order to prove conservation of energy.

- Measurement of speed was implemented using distance sensors (ultrasonic) placed at short distances from each other, between which speed can be assumed to be constant (as the distance is very small)
- The time lapse between each UV sensor lighting up is recorded and speed can be calculated.
- Once we have all the required measurements, the energies are given by

$$\text{KE} = \frac{1}{2}mv^2$$

$$\text{PE} = mgh$$

- To prove the law of conservation of energy, we prove that:

$$KE = PE$$

$$\text{i.e, } mgh = \frac{1}{2}mv^2$$

- The object is contained within the inclined plane by a protrusion or ridge that catches it before it rolls off the plane and aids in carrying the marble back up the plane.

- A second motor rotates the conveyor belt and sends the marble back up it in order to tip it back over to the original inclined plate where it rolls down and the whole process is repeated.