



Design and Development of an IoT-Based Dynamic Self-Stabilizing Mobile Platform for Healthcare Applications

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Abstract

Lifestyle has been much enhanced through the internet of things (IoT) and the internet of things multimedia (Name IoT smart Healthcare, IoT smart Homes and IoT Smart transport). We have a self-adaptive security model of the IoT multimedia and we describe one of the scenarios in the environment of a mobile e-health system where we utilize a knowledge adaptation loop, a type of loop of thought an adaptation model (monitor-analyze-plan-execute) in order to determine the demand of the adaptation to the level of confidence of the various security factors. This is dictated by the adaptation requirement that indicates that within a constantly unstable and sustainable e-health IoT multimedia space, one will be required to adapt ionize the security issues to stabilize the IoT multimedia space. The given paper includes the construction and design of a two-degree-of-freedom self-balancing mobile platform that is not only dynamic, but is also constructed using low-cost materials. This research covered self-stabilizing control system is not only applicable to the vast majority of medical, military and logistical systems but it is impossible not to attribute the importance of this control system in operation in the case where the surface of the ground cannot be considered even or smooth. The platform is developed in a mechanical manner boasting a two-degree-of-freedom of motion. The whole stab system of the stabilization control is developed on the basis of Arduino UNO microcontroller. The longitudinal movement, and the lateral movement in reference to X and Y axis can be controlled with the help of the servomotors. This is an algorithm that was developed in order to convert the digital information of the gyroscope to the angular position of the system and apply the complementary filter and proportional controller on the same. The scale is further employed in determining the tilt of the platform by the comparison between the scale and a familiar functional. This angle of tilt is then converted to a rotation angle which would allow working of the servomotors.

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INTRODUCTION

Internet of things (IoT) is a general communications network comprising of linked objects in a sustained communication stance with each other and their human counterparts in the web. Such physical objects as furniture, cars, personal digital assistants are also hardware that are physical (they are composed of concrete and metal) yet have sensors, actuators as well as electronics that allow them to act with smarter behavior. This is estimated to be 20.4 billion networked devices in the IoT where according to a report done by Gartner almost everything will be networked by 2020. This is coupled by increasing interoperability of majority of the heterogeneous IoT multimedia system where there is multiplicity of connected devices alongside it the level of system threats and breakdowns. In the recent past, WannaCry ransomware attack had been spread in more than 200,000 systems distributed in more than 150

countries. Numerous types of government and business ventures were greatly destroyed. The victims of the cyberattacks are the IoT multimedia systems, networks and devices. The problem of Data computation adaptive security and data privacy are serious issues in the event of the IoT revolution when billion devices are present in the system of mutual coexistence through the use of the internet. This translates to 92 percent of the data that is the subject of the IoT and is saved on the clouds by 2020 because of managing the processes involved in the operating of the IoT multimedia and recording the raw data on the cloud-based network at real time. The first problem is security; no matter all the attributes that a cloud possesses. The self-adaptable security is necessary in the case of the IoT multimedia on the basis of various reasons, which will be discussed in the subsequent paragraphs. To begin with, in a heterogeneous environment like the IoT multimedia setting, there is the difference in the number of devices that have different platforms and protocols which have different hardware of different configurations.

The IoT multimedia system cannot be managed through a single standard of security and universal security mechanism that can apply to all the various devices that it is related to. Recently, the security standards in the Internet of Things have been created by some of the standard-setting organizations including the International Organization for Standardization/International Electro Technical Commission Joint Technical Committee, European Telecommunications Standards Institute and the Telecommunication Standardization Sector of the International Telecommunication Union. Second, the IoT multimedia devices are small and do not accommodate the high sophisticated encryption necessity and transport layer security. Third, as the topology of the IoT multimedia is a dynamic network, it implies that it requires a large number of communications. The key security requirements of the multimedia communication protocols on the IoT are flexibility and incumbency. The IoT multimedia platform does not have self-adaptive security and privacy mechanisms required to achieve dynamic environment of the IoT multimedia and the changing threats.

The smart phone platform is wobbly and it is continually falling over. It is a challenge in that, the mobile platform is continuously moving and altering position, and hence, it is hard to track it. Also, the mobile platform is not autonomous, meaning that one will have to enact it to lie flat on the horizontal side. The project will create a dynamic stable mobile platform, which could be applicable in different circumstances (Wan and Ahmad, 2018). This research aims at coming up with a self-stabilizing mobile platform that is dynamic and can find application in many aspects. The platform will be grounded on the idea of IoT and will employ sensors and actuators to derive and manage its environment.

The platform will be such that it is modular and scalable in the sense that it can be modified to suit application in other applications. It will also be capable of working across numerous conditions, such as indoors and outdoors (Liu & Julien, 2019). The study will be on how the hardware and software of the platform will be developed. This will involve development of sensors, actuators, controllers as well as algorithms. It is hoped that it will provide an easy-to-use platform that can be implemented across a large variety of uses.

- To provide a vibrant self-stabilizing platform of healthcare applications.
- To test the platform in extensive health care uses.
- What are your key research questions that should be answered to create a developing self-stabilizing mobile platform with the use of IoT?

- What are the security parameters of the multimedia self-adaptive security in the IoT?

What aspects should be analysed so as to evaluate self-adaptive security strategies?

What are the theoretical frameworks applied in executing preventive measures of self-adaptive security? (Lucas-Estañ & Gozalvez, 2019).

- What are the main issues related to the development of such platform?

How can IoT be compared to allow dynamic self-stabilizing mobile platform?

What are the advantages of making use of IoT in this case?

The research offers a foundation to the future study in self-stabilizing mobile platform. This can be done to enhance the design and operation of such devices using the findings. Furthermore, the research can be used to inform the discussion of the use of these technologies in the policy processes of the population (Cho & Ko, 2017).

LITERATURE REVIEW

The History of IoT-Serdios mobile platforms, dynamic and self-stabilizing

The development of the Internet of Things (IoT) has introduced the breakthrough innovations, especially in the realm of the mobile platform that is dynamic and self-stabilizing. With the invention of these advanced platforms, they utilize the power of IoT to facilitate flawless communications and exchange of information between two or more devices to maintain balance and stability. A transformative potential of this technology is spread through its range of applications, starting with transportation and moving to logistics and manufacturing as these effects are highlighted by the an insightful research conducted by Wan and Ahmad (2018).

IoT in Transportation: Greener Effectiveness and Sustainability

The IoT implementation in the transportation sector marks a new epoch as it is likely to be used to optimize the current systems. By enhancing the real-time exchange of data conveying the state of the traffic, such dynamic platforms have the ability to smartly divert vehicles around the congestion and eventually decrease the traveling time and minimize the use of fuel. In addition, the IoT-based control of the location and state of the car allows the provision of real-time information regarding the maintenance needs and safety issues, which leads to a safer and more streamlined transport system.

Optimization of logistics by using IoT

The use of the IoT in the logistics industry presents a breakthrough in the inventory and shipment control. As the level of inventory and shipments are tracked in real time, it becomes possible to control the amount of stocks and secure shipments in time. Also, the IoT platform is central to measuring the state of deliveries in transit, providing the possibility to prevent possible damages or losses of products. Kanellopoulos and Sharma (2022) highlight the paradigm shift that the IoT makes in facilitating logistics activities.

IoT in Manufacturing: Accuracy and Effectiveness Liberated

With the application of IoT, there is an upsurge of efficiency and accuracy when it comes to manufacturing processes. Manufacturers are able to detect any defects or

problems in the manufacturing line, and this would ensure that the complications are not reached down the production line. Also, through IoT, there is easy access of location of products in the supply chain making sure they arrive on time to final consumers. Integration is emphasized by the studies of different scholars where IoT redefines the manufacturing practices.

The emergence of Automated Systems in different Industries

With the recent development of new technologies, automation has become very common in numerous fields including transportation, business delivery systems, the army, and medical work in hospitals, among others. Due to the continuous advances in development and execution, robots are becoming an unavoidable part of life, being able to automate operations with unparalleled precision. It is interesting to note that self-stabilizing robots are expected to stand out because of their simple mechanical design that requires no complicated steering mechanisms (Liu and Julien, 2019).

Study and development of Dynamic Self-Stabilizing Mobile Platforms

In difficult conditions, research activities are being done with the aim of controlling complex and nonlinear systems. The study focuses on the issue of designing and developing a self-stabilizing mobile platform, especially the implementation of small-scale mobile robots. The proportional controller takes the center stage in this design, and this guarantees stable system in the occurrence of disturbances. It is noteworthy that there are considerable efforts to ensure that the overall cost of the project is kept low, so that it can be applicable in an array of installations.

Since mobile robots are used under conditions potentially hazardous to equipment and operators, their design must be sufficiently safe to prevent widespread loss in case such a situation occurs. < | human | >2.7 Safety and Efficiency in the Design of the Mobile Robot: Because mobile robots are operated in conditions that have the potential to complicate the safety of equipment and people involved, their design should be safeguarded proficiently in order to ensure that when such a scenario arises, there can be no massive loss.

With regard to the progress of wheeled robots, vibrations and shocks, unfortunately, are in order of the day. The safety of the items that are carried along with their transportation is stressed, which explains the paramount significance of the self-stabilizing feature. Lucas-Estaan and Gozálvez (2019) research highlights the intention to show how to design and implement a dynamic self-stabilizer mobile platform, which comprises two degrees of freedom in a small-size robot of a mobile platform.

To sum up, the integration of the IoT with the self-stabilizing mobile platforms on the fly is a breakeven point in technological innovation. According to the optimization of transportation and logistics, the re-forming manufacturing operations and the beginning of the new era of automated systems, this combination makes industries efficiently and precisely run as never before. The current studies on self-stabilizing mobile platforms are another example of the dedication to solving challenges and developing the capacities of these groundbreaking technologies.

The platform will be horizontal in parallel due to the control afforded by the manipulator platform which is two degrees of freedom. Here, the X and Y movements that are also referred to as lateral and longitudinal movement are regulated by two

links, respectively. Fig. 1 provides the block diagram of the dynamic self-stabilizing mobile platform (Wan and Ahmad, 2018).

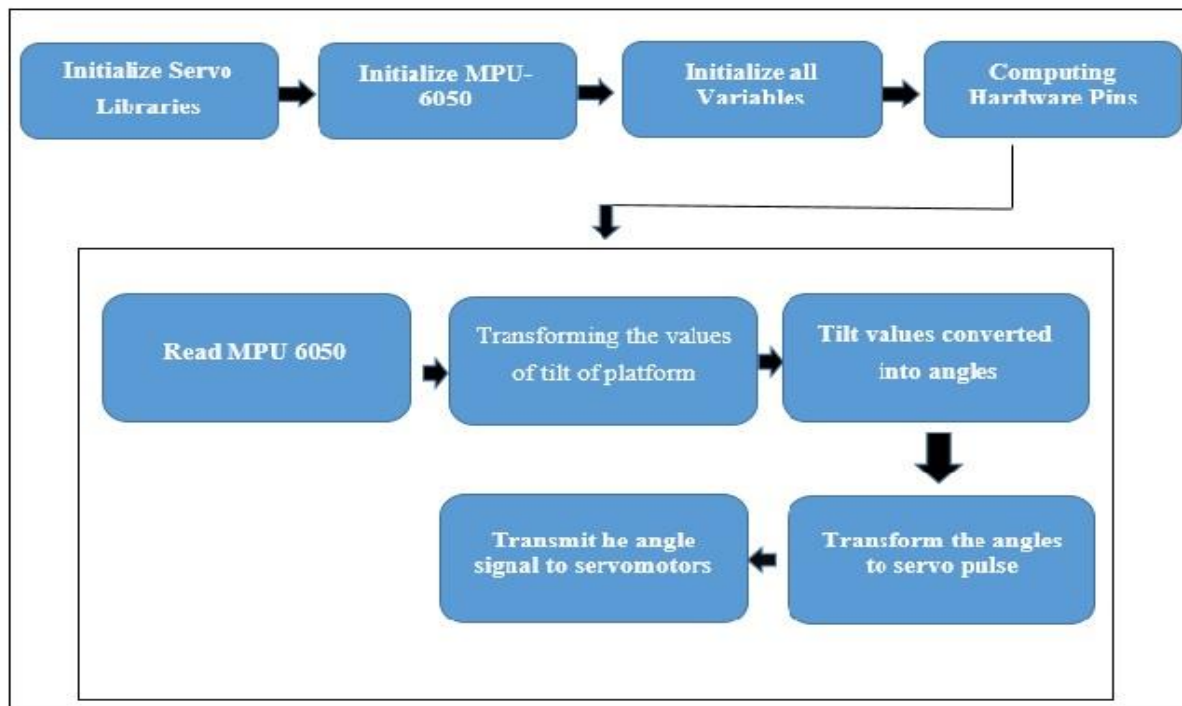


Figure 1.
Block diagram of the dynamical mobile platform self-stabilizing.

The MPU-6050 is able to detect movement of the mobile platform and therefore, when it is being used or steered on uneven or sloping surface, the mobile robot gets unstable. The proportional controller then sends the signal to the complementary filter that regularizes the signal of the self-stabilizing mobile platform which is dynamic in nature.

RESEARCH METHODOLOGY

The Design of Machines: Making a Solid Foundation

Considerable care was taken in the construction of the self-stabilizing square platform, the sides of which were 16 inches high, in the field of designing machines. The design also involves 15.3 inches to be the width of the front and the rear and a slightly less 13.2 inches to the width as the left and the right sides. The designation wood was selected as the material of choice to build this new platform based on three merits of lightness, affordability, and manipulateness. The choice of wood made it easier to drill the holes and attach the supports fluently which is important in placing the servomotors that are essential in functions of the platform.

Strategy Material Choice: Building on the Multifunctionality of Wood

The choice of wood as the main material cannot be overlooked due to its structural convenience as well as to its versatility to the individual needs of the self-stabilizing platform. The given decision enables a reasonable compromise between structural integrity and the necessity of a lightweight setting. The convenience of creating holes into wood and then attaching the supports to it is the best example of how the discussed decision can be viable, particularly when it comes to the location and stabilization of the servomotors.

Mobile Robot Integration: Form and Function Melding

This self-stabilising platform synthesis which uses a mobile robot with four wheels is a perfect balance between form and functionality. This union complements the versatility and flexibility of the entire system whereby the entity becomes dynamic in order to maneuver through all kinds of terrains. A visual illustration of the structure setting that would be visualized during the design stage is in Fig. 2, which depicts the trimetric view of the mobile platform according to the Computer-Aided Design (CAD) of the mobile platform.

Accommodating Differing Grounds: a Strength of Endurance and Agility

Since the self-stabilizing platform is attached to the mobile robot, it would be exposed to the reality of translations and vibrations. The capability of the platform to withstand stability and resist vibrations in the course of a different plains trip is an attribute of the strong design of the platform. The study of such challenges presented by Liu and Julien (2019) in the framework of mobile platforms helps to understand the complexity of the processes of transferring design ideas to practice.

Essentially, the machine design stage becomes a foundation of the self-stabilizing platform, not only regarding the physical size and the choice of the material but also in its connection with the mobile robot and its future functionality when it comes to responding to outside forces. This holistic concept is what guarantees the platform is not just a rigid or traditional design but rather a flexible and responsive system which is eager to work effectively in the real world.



Figure 2.
Mobile platform Trimetric of mobile platform CAD model.

This means that the two independent variables of the system are direction and function because the two degrees of freedom of the system (Pitch and Roll axis or 2-DOF) imply the existence of two independent variables of the system. This is the best technology since the corporate can translate and permit the movement of the self-stabilizing dynamic mobile platform in the 2-DOF due to its physical isolation. This system functions flawlessly without affecting the functions and attitude of the stance of the active self-balancing mobile platform despite being confined in the two-degree-of-freedom (2DOF) (Wan and Ahmad, 2018).

ENVIRONMENTAL SYSTEM

MG-996R Motors: The MG-996R servomotor has been selected as it is not so heavy, precise, and the dead bandwidth with centering is superior. The metal gears give it the load and torque of the ergonomics. Our system has the most important feature of being fast since this is a mobile and dynamic self-stabilizing platform. Table 1 below shows the product specification parameters of the servomotor of the system.

Table 1.
Motor Specifications

S.No.	Parameters	Values
1.	Weight (grams)	55
2.	Torque(kg) (4.8v)	9.4
3.	Speed (Sec/60deg)	0.19

MPU-6050 drift: The MPU-6050 sensor, commonly known as an IMU, is the MEMS (Micro Electromechanical Sensor) utilised to monitor the motion of the platform in our self-balancing platform (Inertial Measurement Unit). The IMUs include independent sensors including magnetometers, gyroscopes, and accelerometers that can function both jointly and independently to determine motion characteristics. The current gyroscope and accelerometer, which are combined into one sensor called MPU-6050, or the IMU device, unlike the traditional compass, do not simply look for the North Pole (Cho & Ko, 2017).

REGULATORY DESIGN

The execution plan: It is obvious that every mechanism or actuator has the ability to impose utterly unique movements, as well as arrange itself in a variety of angular tilts for platform construction. It implies movements that are entirely distinct for the manipulator within the same framework. However, each manipulator's management parameters can support the same cycles.

Control system architecture: The fundamental control block diagram of a plant where the system error is fixed by a controller is shown in Fig. 3. The desired value is established using a set point, and the error is controlled using a controller using the mathematical model Eq (1).

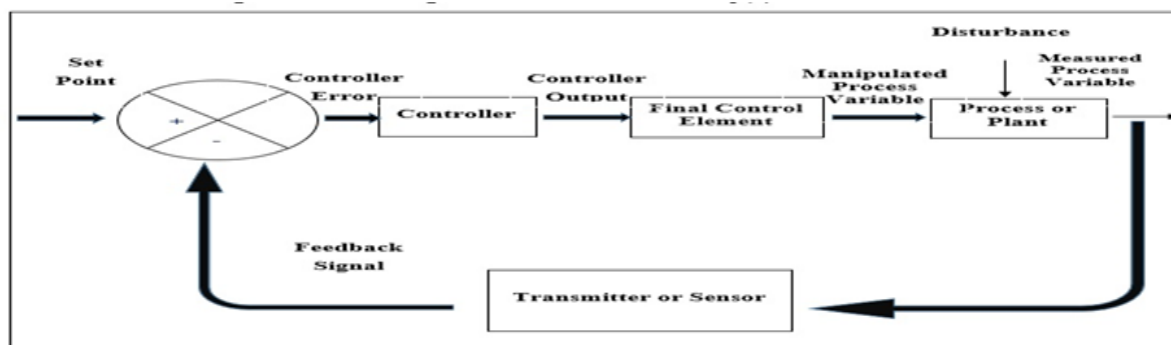


Figure 3.
Basic Control Diagram of Plant

Our default situation:

The control block diagram in our project control scenario, as illustrated in Fig. 4, follows the same pattern when the set point is set, in this case 180. A PWM signal is provided

to the actuators once the error has been calculated in the controller using the reverse acting approach. The servos then turn in response to the signal. The gyro sensor delivers data when something disturbs the platform (Wan & Ahmad, 2018).

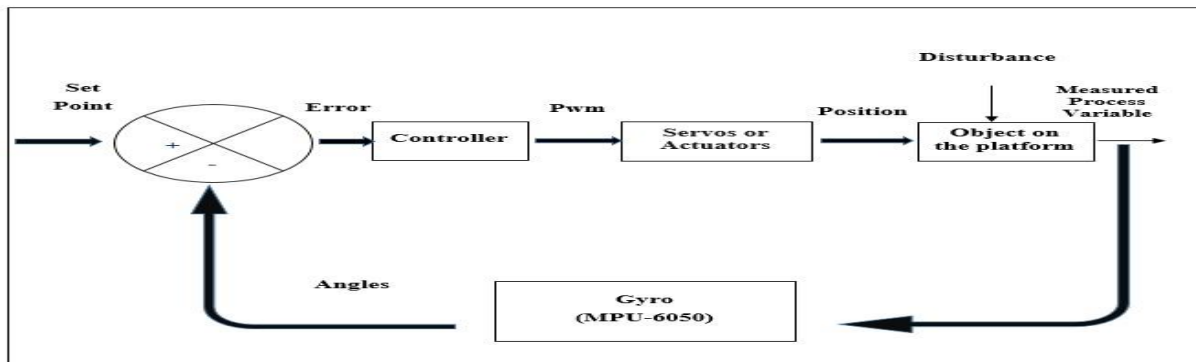


Figure 4.
Control Diagram of Our System

IMPLEMENTATION

Small-scale electronic components, sensors and single-chip microcomputers are in abundance and work quite well at highly restrained power requirements. One of the spheres of innovations is micro-Electromechanical System devices and sensors. This enables the easy labeling of new technology or sensors. They satisfy the needs of minimal effort, reduced size, minimal energy, and weight. The self-stabilizing dynamic mobile platform was developed keeping in mind the concept of using this breakthrough to display and used to host interactions with real world applications. The mobile platform can be dynamically self-stabilized, which can serve more practical purposes in transportation, business, aviation, and robotics, etc. The theory and production of the autonomous platform and available standard parts is the target of the paper. Most of them are cheap and readily obtainable. The result of the project is that balance is maintained when an object is placed on the platform. Nothing has come without its share of technical troubles in the usage that have been avoided. The sensor MPU6050 estimates the data concerning the movement. The control part may be, e.g. an ARM 32-bit processor or an AVR 8-bit processor. On our case, Arduino UNO was chosen (Cho & Ko, 2017).

Its benefits are the following:

it provides a less complex mechanism and costs reasonably.

- Accuracy because of the damped shafting errors of all the motors; improved levelling of the masses being supported.
- The forces of mechanical phenomena are so insignificant that they need hardly be taken into consideration at all.

Content of higher rigidity (Kanellopoulos & Sharma, 2022).

The dynamic stability platform is comprised of the upper platform (a small wooden plank) which is operated depending on upheaval, and the intermediate top servo the location of which is above the bottom servo. The MPU-6050 is just under the top platform where the measurement of the tilt angle is done.

The use of space and slop is less in this type of servo arrangement compared to linkages and hinges. Data stream on Y-axis on the gyro sensor accelerometer is used

to command the Y-axis motor (pitch angle servo) and the X-axis motor (roll angle motor).

The thought of reconsidering many models so as to contemplate frame element and potential essentially. The choices are numerous with one where the base and platform are resting at an equal level and the other where the platform is constructed vertically on top of the main base. We ultimately accepted the second proposal after considering it and having fame. We discovered that using servomotors aligned at right angles to each other enhanced a very high level of stability of the system.

How is Hardware made?

Following steps are involved in the manufacture of hardware of our project. These steps are

Purchasing an Arduino on Ali Express online store. The next task and the next thing to do after this is to find a good quality and cheap sensor that protect us with a real value of the tilt angle. Thereafter we purchased a sensor (MPU6050) that detects the tilt angle as in the case above via aliexpress an online shop sell affordable products.

We purchase these two items after which we get sensor joined to Arduino in accordance with the picture shown below:

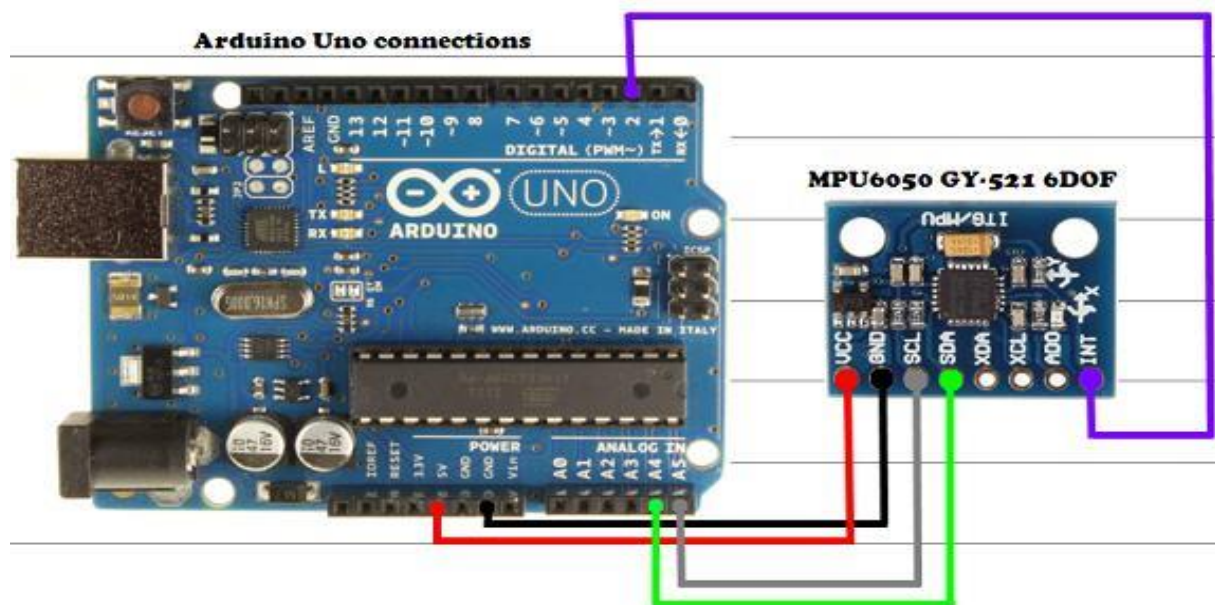


Figure 5. Hardware

After these three steps we download open-source Arduino Software from Arduino website. Then Download mpu 6050 library. After that Add servo library to the file then the Values from the sensor are given to the motors in analog write (tilt angle). Now motors and sensors are calibrated then fix the sensor on the platform and assembled the motors on the platform and also motors are connected in a way that they can rotate at most by considering their mechanical and bracket limits and the brackets used are:

X motor can rotate 40 in one and 45 degree in other direction as mention below the picture

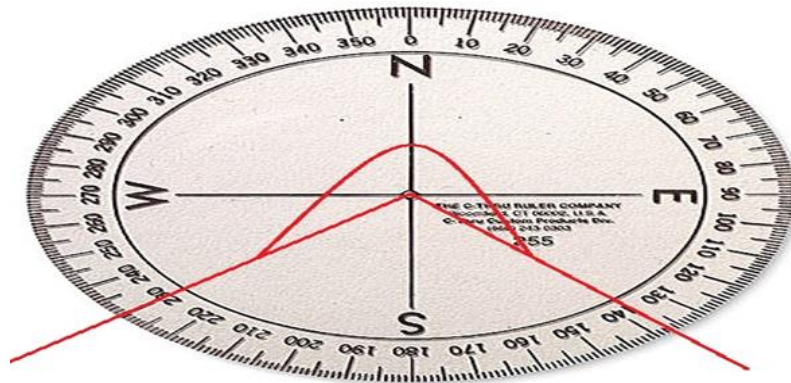


Figure 6.
X motor rotation chart

Y motor can rotate 45 in one and 42 degrees in other direction as mention below the picture

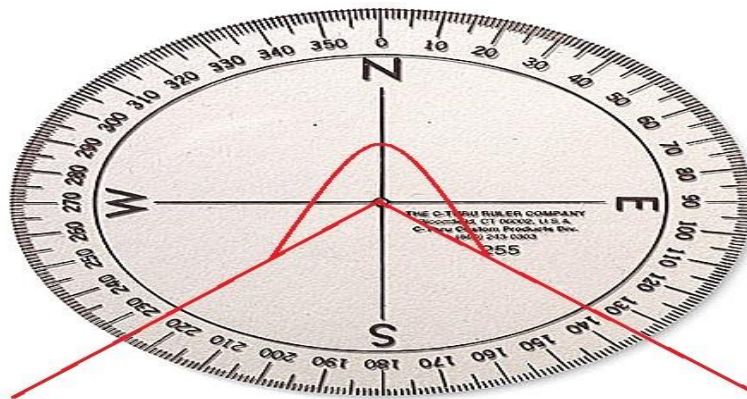


Figure 7.
Y motor rotation chart

Now an upper platform is made on which things are placed to be stable. A platform with servo motor and sensor is now ready. As shown in the figure:

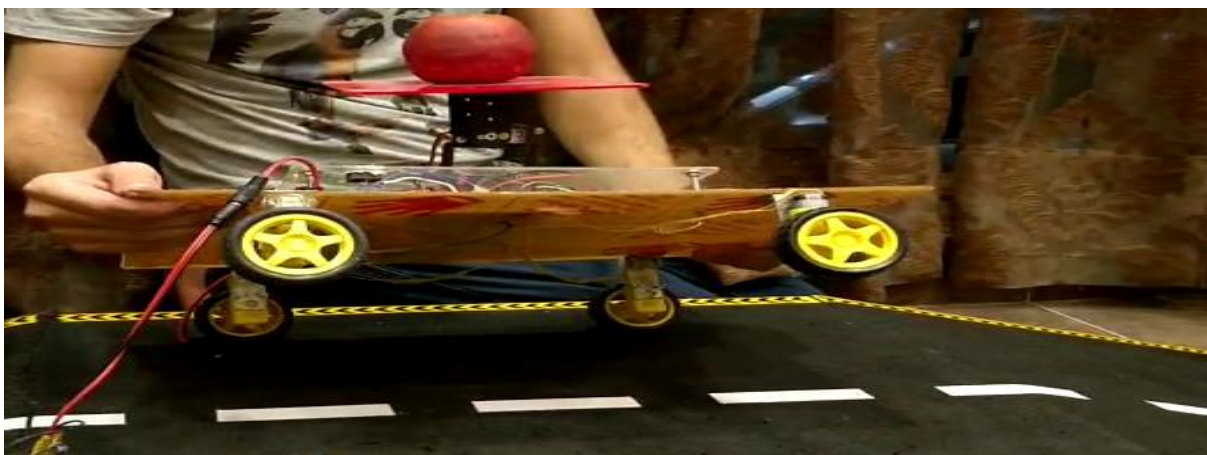


Figure 8.
platform with servo motor

Once we have reached upper platform we need to prove on something that is in motion and so we come-up with a design of car to indicate that when a car comes

out of slopes and we go through obstacles a platform would become stable. And now comes the moment of building a car on which this platform is going to be fixed.

For this we need

- Two set of tires
- Two dc geared motor
- Two h bridges

Remote transmitter and receiver/

To begin with, the body of the car is produced with the assistance of card board. Then tires brackets are created followed by adding dc geared motors in to the bracket. Then we do H-bridge which regulates direction of motor.

What is an H-bridge?

H bridge is a circuit employed to drive an electrical load in one or both directions that a load is applied in the h bridge motor the h bridge motor may be rotated in clockwise as well as anti clockwise direction by the help of h bridge. It is also done on H bridges to provide the load with a desired level of voltages in this manner speed may be varied by changing input voltages of a dc motor.

Following that Print out of PCB on butter paper and Place this butter paper on the copper sheet Iron this sheet till entire carbon moved on the copper sheet. Then prepare FECL3 solution and put your copper sheet into the solution. The copper of the sheet is gradually removed by stirring.

Take out now copper sheet and solution and remove carbon of copper sheet. Then the PCB is ready to work with and then one has to drill the holes with the assistance of a drill machine.

Thereafter identify parts in the PCB and solder parts.



Figure 9.
Fabricated H-bridge PCB used for motor control.

A ready to use H Bridge is now final and completed for use in real circuits. Now fix the h bridge below the card board and Place the tires in motors and then fix the motors in the brackets then Brackets are attached to the card board. After that a free moving

tire is placed in the front of the body of the car, then a transmitter is also fitted below the body of the car.

Now our car is completed, place the servo motor and stabilizing platform on the car to make it a real self-stabilizing car or a self-stabilizing platform.

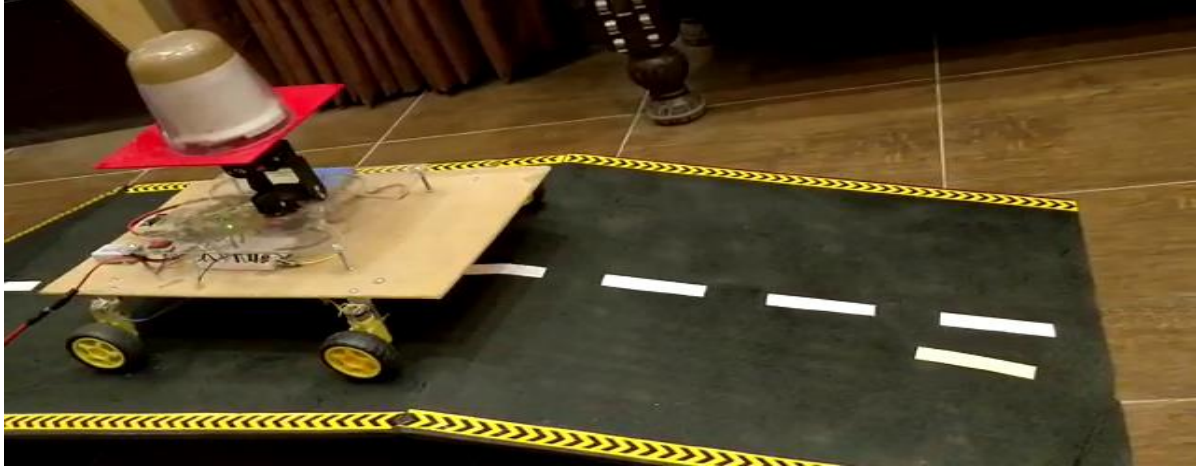


Figure 10.
Prototype self-stabilizing mobile car with mounted platform.
Selecting a Controller

A microcontroller (in other words μC MCU) is a miniature PC on a single coordinated circuit which consolidates a processor, memory, as well as programmable information/yield peripherals. NOR flash or OTP ROM in the form of program memory is often included in the chip, and made of usually small rolls of SRAM. The microcontrollers are to be installed, instead of the microchips used as a component of the PCs or other universal applications.

Microcontrollers have also been utilized in items and gadgets that are naturally controlled such as in vehicle motor control systems, implantable restorative devices, remote control systems, office equipment, control systems, toys and other embedded systems. Microcontrollers lead to conservation of weight and cost than an outline based on alternative microchip, memory, and info/yield devices, causing them economical on digitally controlling far more devices and processes. Blended flag microcontrollers are usual which consist of simple areas which are expected to operate non-computerized electronic structures.

In low consumption of power some microcontrollers can handle four-piece words and also can work with the clock rate at frequency down to 4 kHz. To a large part, they can be useful when tightly tied to an occasion, say, a catch press, or otherwise. What makes them suitable to reliable battery utilisation. Execution basic parts can use different microcontrollers, in which they might be more like a computerized flag processor (DSP), with increased clock speeds and usage of power.

Microcontroller Features

Microcontrollers would be characterised by few to many general purpose information pins / yield pins. Such pins can be programmed as to an info or a yield state. When such pins are laid to a condition of info they are commonly used to scan the sensors / external indications. They work like engineered to the yield expression, can utilize to power outward devices be it LED or motor. The number of installed frameworks had

to be enormous and reading sensors that give simple indication. It is the motivation to the to-computerized converter (ADC) that is easy to compute. Since the processors are occupied in decoding and preparing computerized information i.e. 1's and 0's, it is not ready to do anything with the crude flags that might be sent to it by a gadget. So, the simple to computerized converter is used to convert the information which will be entering into a form that will be experienced by the processor. Another less common component on some microcontroller can computerized to simple converter (DAC) that allows the processor generate simple signals gain or voltage value. Installation of chip also is also present in large numbers and it also includes a variety of clocks despite the converters. The best category of the clocks have received the most popularity include the Programmable Interim Clock.

It may fall down of some degree to none degree, up to the counter limit enrolls, and float to the zero. When it touched the mark of zero, it gave an obstruction to the processor that depicts that it has finished the procedure of giving numbers. The latter can be applied in the example of gadgets, e.g. indoor regulators that sometimes measure the temperature of the space that report about the necessity of activating the ventilation system, the radiator etc. A serious Heartbeat Width Adjust (PWM) piece, allows it for being used to cause those CPU to regulate converters, resistive lots, engines and so forth.,without employing masses of CPU places being a constituent element of clock groupings. Systems wide Non concurrent Collector/Transmitter (UART) square System wide Non concurrent Collector/Transmitter (UART) is such that information may be received and sent on a serial line with practically no requirement on the heap of the CPU. On-chip equipment is also commonly dedicated to add capabilities to communicate to a number of other devices on niche installations that include the I2C and Serial Fringe Interface (SPI).

Choosing Controller for the Project

Selecting a privilege microcontroller for an item or venture is a troublesome undertaking. Not just there are various specialized elements to consider, there are likewise business case issues, for example, cost and lead-times that can impact on a venture. Toward begin of a venture there is an awesome enticement to bounce in and begin selecting a microcontroller before the subtle elements of the framework has been hashed out. This is obviously a horrible thought. Prior to any musing is given to the microcontroller, the equipment and programming specialists ought to work out the large amounts of the framework, square chart and flowchart them and at exactly that point is enough data to begin settling on an objective choice on microcontroller choice. Arduino UNO

The ARDUINO UNO is a microcontroller board as far as the ATmega328 is concerned. The Mega is perfect with majority of shields aimed for the Arduino. It has 14 Advanced info/yield pins (of which 6 pins can be utilized as PWM yields), 6 simple data sources, 16 MHz precious stone oscillator, USB association, power jack, ICSP header, and reset catch. It contains all that is expected to prop up the microcontroller; almost interface to a PC with a USB link or power it with an air conditioner to DC connector or battery to start.

Table 2.

Features:

Microcontroller:	ATmega328
Operating Voltage:	5V
Input Voltage (recommended):	7-12V

Input Voltage (limits):	6-20V
Digital I/O Pins:	14 (6 with PWM output)
Analog Input Pins:	6
DC Current per I/O Pin:	40 mA
DC Current for 3.3V Pin:	50 mA
Flash Memory:	32KB of which 0.5KB used by boot loader
SRAM:	2 KB
EEPROM:	1 KB
Clock Speed:	16MHz



Figure 11. Arduino UNO board used in the implementation. Features used are

1. PWM
2. Digital Input pins
3. I2C Communication

PWM

PWM or Beat Width Adjustment is a kind of process through which we obtain simple results in sophisticated processes. An exchange of a flag of square wave is used to indicate on and off by utilizing computerized control. This on and off example has the ability to generatem voltages between 5 Volts and 0 Volts by varying the time the flag stays on and make the transition through off with regards to the duration of time the progressions. The range within which heartbeat is high (on time) is referred to as the beat width. You may change that width of the heartbeat, to obtain various simple qualities. The green lines in the diagram below illustrate the general day and age. This delay that is represented by green lines is the opposite of the repetition of PWM with Arduino PWM recurrence in 500 Hz the green lines period has a width of 2 milliseconds. A call of simple Compose () capacity goes as high as to an estimated 0-255. I-e a compose (255) shows 100% obligation cycle means when will be relied upon and compose (127) is a half obligation cycle means when will be relied upon half time say:

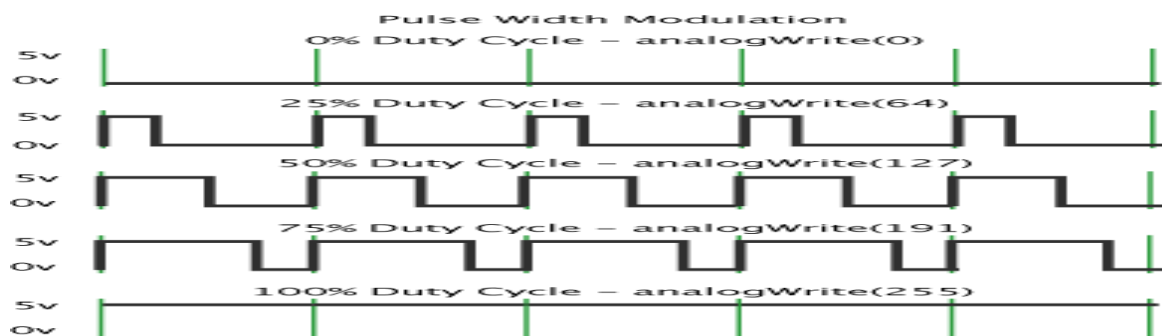


Figure 12. PWM generation

I2C is held and I squared C and it is created by Philips Semiconductor and most normally in the form I2C. This is an abbreviation of between incorporated circuit and its work to allow correspondence of information between I2C devices having two lines. It transmits the information in a serial fashion using one line of information which is SDA and other line of clock which is SCL.

Ace and Slave is presented through I2C portrayals. Ace is a device that contains the control of the transport. This device (Ace) manage the line of clock that is SCL and by managing the flag in the clock then it generates the signs of begin and terminus. Slave is a device that received the orders that are sent by Ace and provide an answer to the orders.

For Example:

The example of I2C which is used in our Project

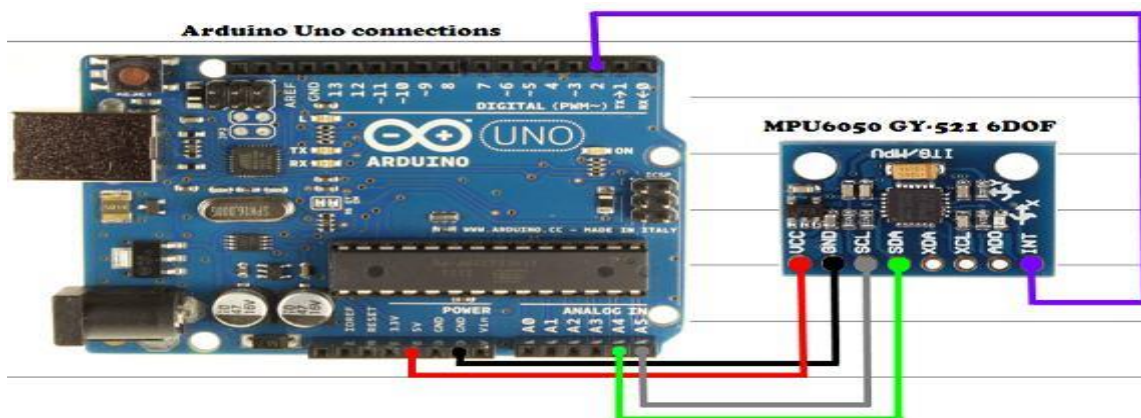


Figure 13.
ARDUINO UNO Pin Mapping
Table 3.

Mapping table of ARDUINO UNO (ATmega328)

Pin Number	Pin Name	Mapped Pin Name
1	PC6	Reset
2	PD0	Digital pin 0 (RX)
3	PD1	Digital pin 1 (TX)
4	PD2	Digital pin 2
5	PD3	Digital pin 3 (PWM)
6	PD4	Digital pin 4
7	VCC	VCC
8	GND	GND
9	PB6	Crystal
10	PB7	Crystal
11	PD5	Digital pin 5 (PWM)
12	PD6	Digital pin 6 (PWM)
13	PD7	Digital pin 7
14	PB0	Digital pin 8
15	PB1	Digital pin 9 (PWM)
16	PB2	Digital pin 10 (PWM)
17	PB3	Digital pin 11 (PWM)
18	PB4	Digital pin 12
19	PB5	Digital pin 13
20	AVCC	VCC
21	AREF	Analog Reference
22	GND	GND

23	PC0	Analog input 0
24	PC1	Analog input 1
25	PC2	Analog input 2
26	PC3	Analog input 3
27	PC4	Analog input 4
28	PC5	Analog input 5
3.10	Motors	

An electric engine is one that changes over electrical vitality into mechanical vitality. The turn of the pole is gotten when the curl encounter a torque constrain due to current moving with an attractive field. For the different engines that are accessible in light of their torque producing ability, there is a scope of reasonable size propeller. Along these lines, the determination of engine should be considered on the account of the propellers. The important criteria that would be taken into account for the choice would be the present draw as this has a significant effect on the flight time and also the possible push that can be produced in order to have the capacity of lifting the UAV. For the most part, the bigger the engine the more push it can produce. As a result, there would be a push for a measure of weight proportion, which would be a better measure for examination.

Types of Motors

There are many types of motors present which classified as given below

DC Motors

- I. Separately Excited Motors
- II. Shunt Motors
- III. Series Motors
- IV. Compound Motors
- V. Permanent Magnet

AC Motors

- I. Induction Motors
- II. Synchronous Motors

Special Purpose Motors

- I. Stepper Motors
- II. Brushless DC Motors
- III. Reluctance Motors
- IV. Universal Motors
- V. Servo Motors

The motor which we used in our project is a special purpose motor there are many special purpose motors but we used servo motor

Servo Motor

A Servo engine is an extraordinary adjusted DC engine furnished with an electronic circuit for controlling the bearing of turn and the position of engine shaft [3].servo engine give exact precise situating of their yield shaft that is the reason it is utilized as a part of numerous fields I-e in apply autonomy, radio controlled autos, planes and vessels and so on . The primary explanation for utilizing a servo is that it gives rakish accuracy, I-e it will just turn as much we need and after that stop and sit tight for next flag to continue the following activity.

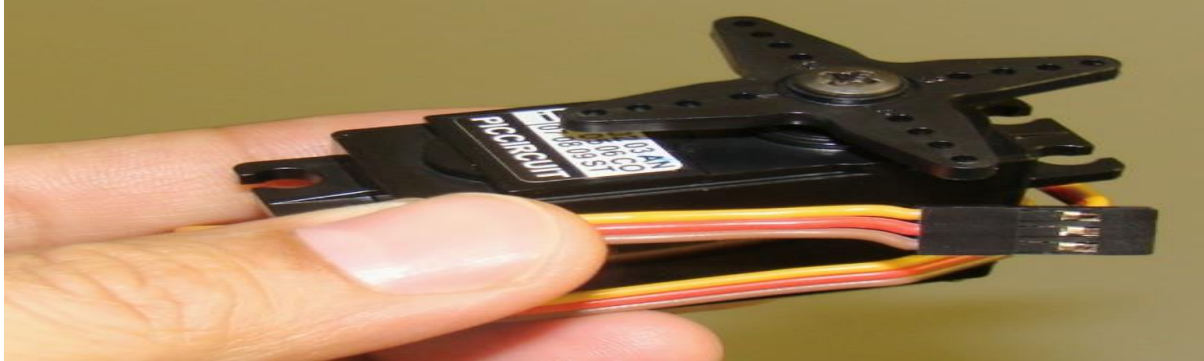


Figure 14.
Servo motor used in the proposed platform.

TYPES OF SERVO MOTOR

There are two types of servo motors [4]

- DC servo motor
- AC servo motor

DC servo motor:

If the motor control is associated with the mechanism of DC motor then servo motor is known as DC servo motor.

AC servo motor:

If the motor control is associated with the mechanism of AC then servo motor is known as AC servo motor.

Construction:

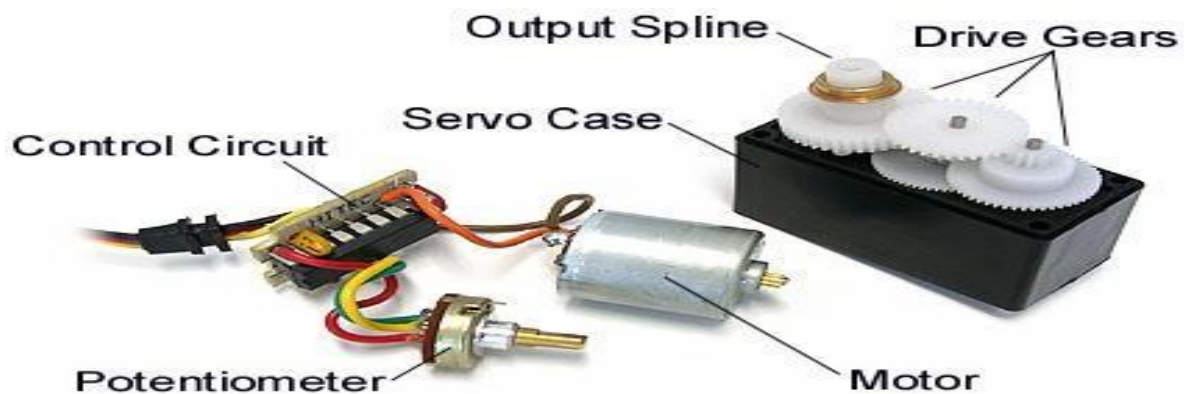


Figure 15.
Internal construction of a servo motor.
Stator

The rotating field of the rotor is generated at the rotor position in order to effectively produce a torque.

Winding

The alternation in the current carries in the winding to produce a rotating magnetic field.

Shaft

The power of the motor output and the load is actioned by transfer mechanism (as coupling) in this part.

Rotor

A low function permanent magnet, that is, a rare earth or other permanent magnet is mounted outside the shaft.

Encoder

Encoder is used as a sensor to count the number of rotations made and monitor the position of shaft.

RESULTS**Comprehensive and Elaborate Dynamic Self-Stabilization Performance Analysis**

The exhaustive examination of the dynamic self-stabilizing mobile platform constituted a comprehensive suite of tests, meticulously designed to assess its multifaceted performance across a diverse spectrum of conditions. With an unwavering focus on the platform's innate self-stabilization capabilities, the evaluations included subjecting it to deliberate disturbances and alterations within its operating environment. This holistic approach allowed for an in-depth understanding of the platform's nuanced responses, drawing insightful correlations between gyroscope readings and motor responses to paint a detailed picture of its adeptness at maintaining equilibrium.

In-Depth Exploration of Responsive Adaptation to Deliberate Disturbances

Delving into the platform's responsiveness, intentional disturbances were strategically introduced along both the X and Y axes, offering a nuanced exploration of its adaptive prowess. Observations honed in on the platform's not just prompt but impressively accurate adaptation to these disturbances. The meticulous documentation showcased its remarkable capability to minimize tilt angles with finesse, reinforcing the platform's stability under intentional perturbations and further establishing its reliability.

Thorough Analysis of Motor Control and Gyroscope Integration Dynamics

The seamless integration between the motors and the MPU-6050 gyroscope within the control system underwent an exhaustive analysis. This involved a meticulous examination of the precision in motor movements in direct correlation with gyroscope readings. The complex interplay between the complimentary filter and proportional controller was laid bare, unraveling the intricacies of how these components collaboratively translated gyroscope data into not just precise but controlled and calibrated motor movements.

Robust Stability Assessment Across an Array of Dynamic Conditions

The platform's stability underwent rigorous evaluation across an expansive range of conditions, spanning variations in surface levels and dynamic environmental variables. The results illuminated the system's robust adaptability to an array of terrains, showcasing its capacity to maintain stability even on irregular surfaces. The dynamic self-stabilizing mechanism emerged as a stalwart, effectively compensating for

fluctuations in the platform's orientation and reaffirming its reliability in dynamic scenarios.

Rigorous Validation through Correlation with Theoretical Expectations

A meticulous comparison was meticulously drawn between the actual performance of the dynamic self-stabilizing mobile platform and the theoretical expectations meticulously outlined in the design specifications. The consistent alignment observed between real-world outcomes and anticipated results served as a robust validation of the effectiveness of the proposed design and control system, instilling confidence in the platform's capabilities.

Holistic Evaluation in Healthcare Applications: Real-World Simulation Insights

The platform's efficacy within healthcare applications was subjected to scrutiny through simulated scenarios meticulously replicating various healthcare-related situations. These real-world simulations provided not just empirical but tangible insights into the platform's performance and its potential contributions in healthcare environments. The positive outcomes affirmed the platform's promise for applications within the healthcare sector, unveiling its versatility and adaptability in critical medical scenarios.

Transparent Exploration of Challenges and Limitations: A Candid Reflection

This chapter also embarked on a transparent exploration of the challenges encountered throughout the testing and implementation phases. Comprehensive insights were laid bare regarding the inherent limitations of the current design, serving as a candid reflection that not only underscores the integrity of the research but also propels future enhancements and refinements.

Forward-Looking Recommendations for Future Enhancements: Paving the Path for Innovation

The section dedicated to future enhancements was not merely a list but a visionary roadmap outlining prospective modifications aimed at elevating the dynamic self-stabilizing mobile platform to new heights. Recommendations spanned augmenting degrees of freedom, expanding application scopes, and addressing identified limitations, providing a robust foundation for future refinement and continuous innovation.

In summation, the Results chapter stands as a pinnacle of comprehensive evaluation, offering an expansive and thorough analysis of the dynamic self-stabilizing mobile platform's performance. It not only solidifies the platform's current potential but also serves as a fertile ground for future refinements and advancements in this cutting-edge technology. This holistic approach ensures that the platform's journey is not just a testament to its present capabilities but an ever-evolving saga of innovation and excellence.

CONCLUSION AND RECOMMENDATIONS

The conclusion chapter serves as the final synthesis of the entire research endeavor. It consolidates the key findings, reflects on the research process, and outlines the overall contributions of the study to the academic and practical realms. This chapter also offers conclusive remarks on the dynamic self-stabilizing mobile platform's significance

in healthcare applications using IoT and emphasizes its potential impact on future developments in the field.

Summary of Findings

A succinct summary of the main findings from the experimental results and their significance in addressing the research questions and objectives.

Contributions to Knowledge

An overview of the contributions made by the research to the existing body of knowledge in the field of dynamic self-stabilizing mobile platforms and IoT applications in healthcare.

Practical Implications and Applications

Discussion on how the developed platform can be practically applied in healthcare settings, highlighting potential benefits and addressing specific challenges.

Reflection on the Research Process

A reflective analysis of the research process, including methodologies employed, challenges faced, and lessons learned throughout the study.

Recommendations for Future Research

Guidance for future researchers in the domain, suggesting potential areas of exploration and improvement based on the insights gained from the current study.

Final Remarks

Concluding remarks that summarize the overall significance of the research and reiterate its potential impact on advancing the understanding and application of dynamic self-stabilizing mobile platforms in healthcare through IoT.

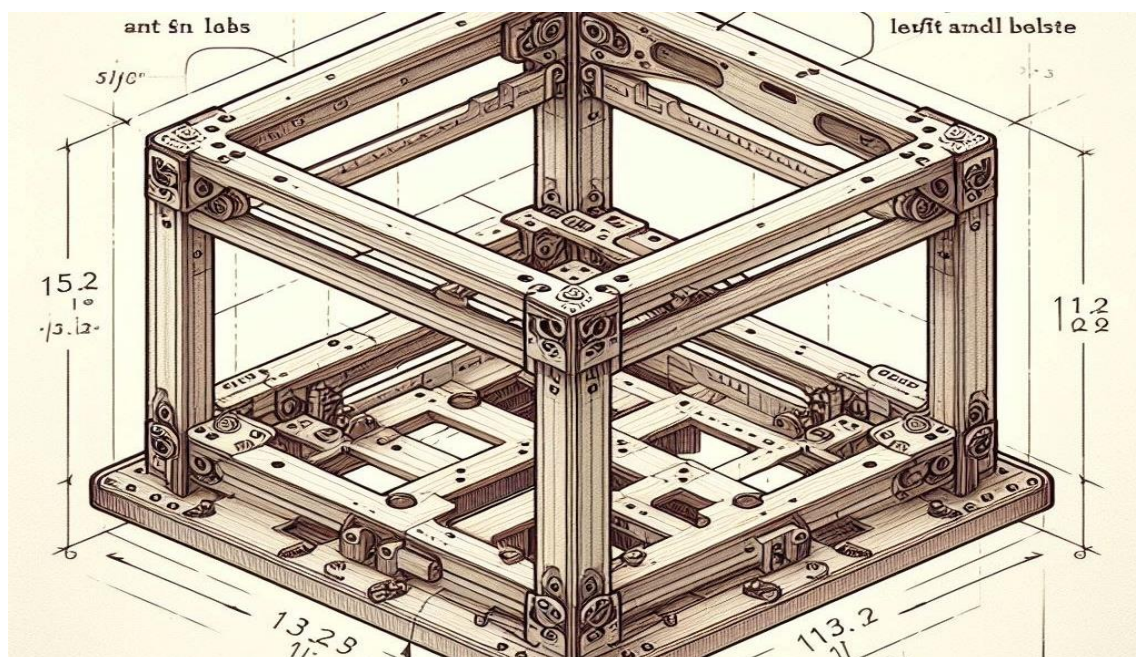


Figure 16
Implementation of Self-Stabilizing Platform

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