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A Novel Design of Phone Curvet Protection Mechanism

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ABSTRACT:- Smartphones are habitually used by common people for performing various tasks needed for their livelihood. These phones are so fragile that care has to be taken while handling them. Handling these phones can be tricky and occasionally they may fall damaging the phone. This paper aims to suggest a feasible method of freefall protection system for existing smartphones. The various sensors and components required for the design and development of the system are enlisted and elucidated. The interfacing of the microprocessor with other sensors is well briefed. The functioning of the system is explicated with the aid of block diagrams.
Keywords:- Curvet protection system, Eccentric motors, Freefall sensor, Gyroscope and Smartphone.

I. INTRODUCTION

Currently smartphones have become indispensable for increasing productivity and improving the efficiency of human lives. They are often used to perform our day to day tasks. A small yet influential device is swiftly changing the traditional way human beings lead their life. These are devices built on mobile computing platform with more progressive computing capability and connectivity. However, there is no explicit protection system to protect a smartphone to avoid any unintentional damage from free fall. Even though the introduction of tempered glasses prevents the shattering of the phone's screen to an extent, it does not protect the internal components of the phone from the fall and is not a complete solution. The smartphone market is increasingly vivacious and attracts a lot of day to day consumers. Unintentional slippage from the hands of the user results in damage of the device and the repercussion is quite undesirable. Hence, it is very necessary to have a seamless solution to protect the phone from any unintentional dropping and free fall. This research focuses on developing a state of the art phone curvet protection system by using existing technology. This system is fully automated and is capable of detecting free fall and protecting the phone from any damage.

II. METHODOLOGY

2.1 Fluid Medium

The fluid medium is the working substance of the system. The system designed is micro pneumatic in nature and the fluid medium used is compressed/pressurized air. Air is a mixture of gases and has less inertia, making acceleration and deceleration easier. Compressed air is capable doing light duty works. Air can be inducted and exhausted directly to the atmosphere as it is not hazardous. The air which is compressed by external means is fed into the canister through a valve. When the valves open, the compressed air flows through the delivery tubes to the nozzle. Thrust is produced when the compressed air leaves the nozzle. The major advantage of air medium is that it is highly compressible, readily available and is nontoxic in nature.

2.2 Constructional Details

The system designed by us consists of the following components:

1. Pressure Canister
2. Free fall sensor
3. Gyro sensor
4. Microprocessor
5. Encapsulated Motor
6. Delivery tubes
7. Solenoid actuated valves
8. End nozzle

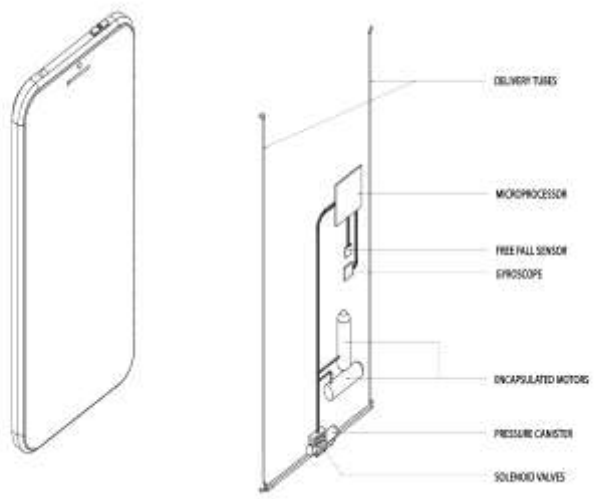


Figure 1 Isometric view of components of the system

2.2.1 Pressure Canister

A pressure canister is a metallic cylinder that holds any pressurized fluid inside it. The canister in our case holds compressed fluid (air) and it acts as a reservoir. The compressed fluid is fed inside it by external means. The inlet port of the canister contains a micro Schrader valve which allows motion of the fluid in only one direction thus preventing leakage and backflow. The canister is capable of handling very high pressure amounts. The canister holds the compressed air sufficient to survive a single fall. Four outlets are drawn out from the canister.

2.2.2 Freefall Sensor

A free fall sensor is actually an accelerometer which is used to sense if a device has been dropped and is falling. These accelerometers are often small *micro electromechanical systems* (MEMS). In fact accelerometers measure proper acceleration and not coordinate acceleration. Using straight line motion equations, velocity can be found out knowing acceleration. Once the falling device reaches critical velocity right after a few moments it is dropped, the free fall sensor intimates the microprocessor. The length of time in free fall is used to calculate the height of drop and to estimate the shock to the package.

2.2.3 Gyro Sensor

A gyro sensor is also known as an angular velocity sensor. In recent years, gyro sensors have found their way into camera-shake detection systems for compact video and still cameras, motion sensing for video games. The gyroscope sensor within the MEMS is tiny (between 1 to 100 micrometers). When the gyro is rotated, a small resonating mass is shifted as the angular velocity changes. This movement is transformed into very low-current electrical signals that can be augmented and read by a host microprocessor. The gyro sensor keeps on feeding the microprocessor about the phone's orientation in space. This will give an insight to the microprocessor in which orientation the phone is falling.

2.2.4 Microprocessor

Microprocessor is a programmable electronic device. It is clock driven, register based, multipurpose computer processor. It incorporates the functions of a CPU onto a single chip. It accepts binary or digital input, processes it according the stored program in its memory and gives an output. The microprocessor is the most important component in this system. This age Smartphone's microprocessors are known for their reliability and rapidity. The microprocessor is capable of solving various equations and attaining at the required output.

2.2.5 Encapsulated Eccentric Motor

A motor is an electrical actuator which converts input electrical energy into rotational mechanical energy. Two of these dc motors are placed inside the device perpendicular to each other. Both motors lie on the plane containing the phone. These motors are used to shift the orientation of the phone in midair. Each of these motors is fitted with an eccentric mass. When these motors rotate, dynamic imbalance occurs producing a couple and a centrifugal force. The resultant centrifugal force is eliminated by placing two eccentric masses diametrically opposite to each other. The resultant couple produced is responsible for shifting the phone's orientation.

067 tubes is a critical factor since friction can greatly vary with surface roughness.

2.2.8 Solenoid Actuated Valves

A solenoid is an electromechanical device which can convert electrical power into mechanical force and motion. Solenoids provide a push or pull force to remotely operate fluid power valves. These valves are used to control the mass flow rate of the compressed fluid which indirectly affects the thrust produced. The size of these valves can be as small as the size of a pencil tip. It consists mainly of a plunger, wire or coil and a body. The parts of the valve are to be made from laminated sheets to obstruct the flow of eddy current and to avoid increase of the solenoid body temperature.

2.2.9 End Nozzle

A nozzle is frequently a tube of varying cross-section. The main purpose of the nozzle is to increase the velocity of the fluid flow. The velocity of the fluid flow increases at the expense of its pressure energy. Increasing the kinetic energy of the flowing medium will increase the thrust produced dramatically. This is required because the time available for the phone to reach the ground is very limited. Thus in that short span of time, a large amount of thrust has to be generated to counteract the impact energy due to the fall. Nozzle serves this purpose. There are four of them near the phone's edged facing downwards at an angle.

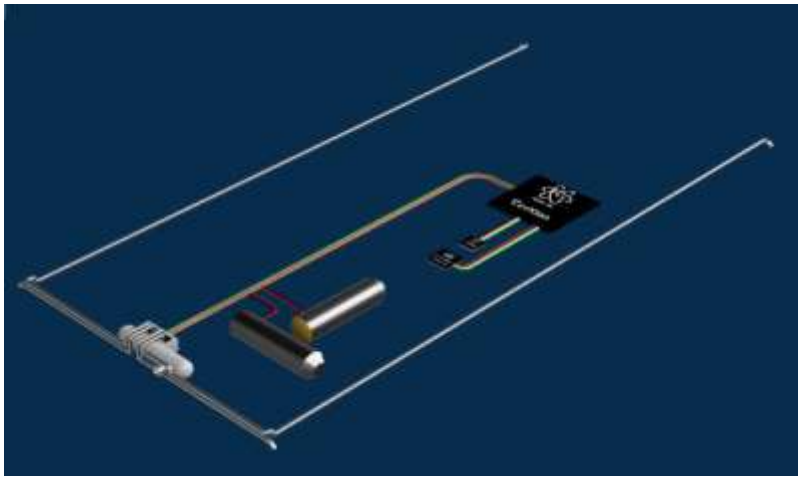
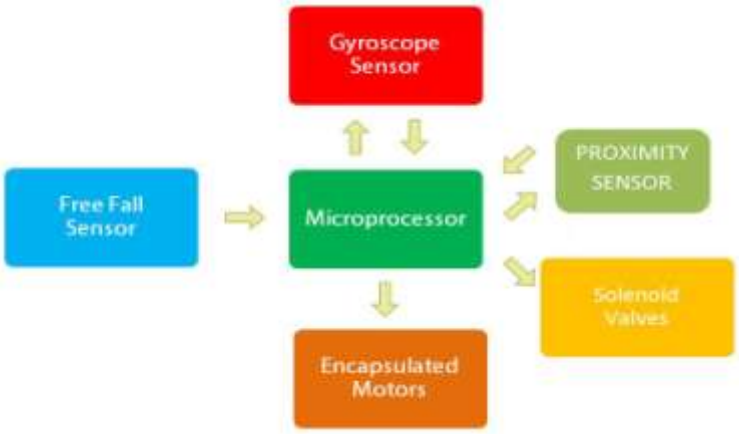


Figure 2 CAD model of the system

2.3 Working Protocol



III. FUNCTIONING MECHANISM

The instant when phone is dropped, it will start accelerating towards the ground due to gravity. As it accelerates, its velocity increases and this principle is used in the free fall lock sensor. The free fall lock sensor monitors the fall velocity continuously. When the fall velocity reaches the critical value, the sensor sends a signal to the microprocessor. Once the microprocessor gets input from the free fall sensor, it collects data from the gyro sensor to know the position of the phone during its fall. The primary thing the system tries to achieve is

to bring the phone to a horizontal position with the screen facing up. The microprocessor determines the couple that has to be generated in both the axes to bring the phone back to horizontal orientation. Since the couple produced is a function of angular velocity of the motor, the microprocessor sends signals to the motor to rotate at the required angular velocity such that the couple requirement is met. As said earlier, the couple is produced due to the dynamic imbalance. This restores the phone in horizontal plane with respect to the ground. When the eccentric motors are operating, the microprocessor still gets feedback from the gyroscope to ensure whether the device has attained a horizontal orientation. The phone would still be falling though.

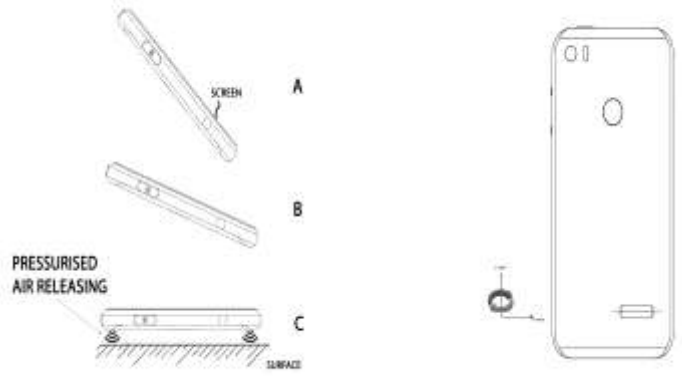
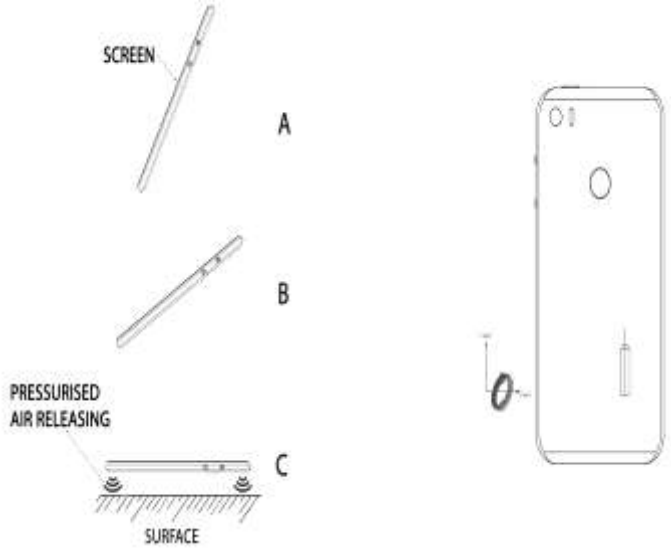


Figure 3 Phone changing orientation in y-axis

This position is required because a proximity sensor is placed underneath the phone to detect the presence of the ground while falling. The proximity sensor has quite a long range and it detects the presence of floor a few centimeters before the phone actually reaches the ground. The proximity sensor indicates the microprocessor when the surface comes into the range of the sensor. This time is enough for the microprocessor to calculate the height of fall and thus the impact that is going to occur on the device. This helps in estimating the thrust the nozzles have to deliver in order to counteract this impact force.



The calculation of height starts from the instant free fall sensor gets a lock on. This is achieved by solving the equations of motion with time and velocity known at each instant. This height added with the range of the proximity sensor will give the total height of the fall. Now that the microprocessor knows the height, velocity and acceleration even before the phone hits the ground, it calculates the appropriate amount of thrust to be generated. Right when the phone is not many centimeters above, the microprocessor actuates the valves accordingly to supply the same creating a cushion effect which prevents the phone from any unintended damage. The canister can hold the compressed fluid for sustaining a single fall. It can be recharged by external means.

IV. CONCLUSION

In this paper the concept of a phone protection system with the help of air thrusters has been elucidated. The various sensors, its contribution and the architecture for the same have been depicted with the help of illustrations. The advantages over the other safeguard systems is justified by the protection of inner components during the fall using air which is a non-toxic highly compressible medium and presence of a microprocessor which swiftly actuates the solenoid valves for thrust initiation thus making the system reliable. A few limitations however exist. When the phone is dropped from a height greater than 1.5 meters the system fails to achieve 100% efficiency i.e. the thrust produced is not sufficient to ensure complete safety. There exists a possibility of shutting of nozzle openings due to foreign particles. The system can efficiently provide protection for only a single fall. The canister has to be refilled after each and every fall. Since updating possibilities are endless, the refinement of limitations is kept as a future scope. As an end thought, the system can be improvised and incorporated in delicate devices for fall protection which is the ultimatum of this paper.

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