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Military Applications of MEMS Technology

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Abstract

The paper is centered on the study of applications on MEMS based sensors in military regions. The study initially deals with a MEMS sensor which is capable of monitoring the missile altitude and its rotational roll rate along with its pitch and yaw. Missiles are being exposed to outer conditions and hence needs to be inspected continuously for its proper maintenance. Further in past few years the advancements in this technology also deals with MEMS sensors used in missile health monitoring, and the utilization of optical MEMS for beam steering of the missiles and packaging of these miniature devices and integrating it onto the military arsenals.

Keywords: MEMS, sensor, military arsenals, rotational roll rate, altitude

INTRODUCTION

MEMS empowers technology for future military needs to improve integration (small), efficient, and "smart" networks to enhance efficiency and expansion (performance) capacity at lower cost and weight. Health and Safety Monitoring Systems (HUMS) accommodates MEMS sensors that monitor the health [1]. The concept focuses on the combined temperature of the monitoring systems, humidity, vibrations and other life-affect parameters. HUMS is particularly useful in the powerful parts (explosives) of the weapons system because they are extreme environmental conditions. Currently, the service life of weapons are based on the batches produced or most of the conditions specified in the end and risk testing [2]. This results in the removal of all lots of stocks and premature landings. All weapons are generally treated equally even one lottery machines feel with different storage conditions. The missile displayed over a period of time other than the design envelope may be inspected for inspection. Missiles that are mildly exposed can be selected with sensitive equipment requests and the distribution of equipment is observed on previous use to avoid overuse. (HUMS) which are currently being developed use two sensory data analysis techniques. Many HUMS identify system life by examining the vibrations for features that indicate an error or damage. It is known that practical life Expectations are highly dependent on natural factors such as stored temperature.

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STUDY

Mainly two technologies have come up to overcome the challenges:

1. (RFID) Radio Frequency Identifications
2. Low Power Consumption MEMS sensors.

The RFID employs a bar code system with the use of a low power consumption transmitter to a receiver module and then transmitted finally to a computer. This tends to provide a higher accuracy of the obtained data. When a RFID based tag is combined with various sensors based on temperature, pressure, shock, humidity, etc. this data can be reviewed from time to time in order to maintain a complete report. The MEMS sensors on the other hand record the tags overall performance.

Suppose the limit is exceeded, the flag shifts to a set condition and at the preceding counting time of the flag a message is being transmitted thus indicating a corrupt performance. Thus, the shock sensation of the recording is not recorded managing (discarding) ordnance and setting up a future investigation flag to show that ordnance was inappropriately used and testing needs to be done before any further use [3].

Guidelines for health monitoring systems should be prioritized for the continuation of implementation plans and to promote user interest / support and commitment. A guide to assist the health monitoring systems in order to integrate it with the existing systems is discussed in the study. These Health monitoring devices will have a wide range of applications and its demand would increase in the upcoming decades. The market prospective is quite high and vast and has logistics applications as well [2].

Barriers include higher power consumption in MEMS based technology, wider range of access, and reliability is necessary. This study uses the band's melting sensors to absorb energy and efficiency. The utilization a broadband sensor in order to monitor only the dominant and directed waves. The sensor produces data which barely requires any signal processing techniques, the use of a microcontroller and even the extra time that is required and thus enables reduced power consumption and extended battery life using a large feature scale and a large amount of evidence for a silicon etching background process. The approach tends to be similar for other such processes gaining good success in the energy consumption factors.

The research focuses on the creation, production and simulation of the first generation, low frequency MEMS vibration sensor. An elemental and finite eliminating model was developed, further design was developed to a visual geometry referring to the directed performance specs. The sensors are fabricated and packaged at micro level and are then administered to determine properties relayed to mechanical, piezoelectric and electrical at the type of material used and device. The outcomes show effective performance and close proximity to predicted specifications [4].

The military Sector assist the evolution of a high performance (MEMS) instrument with applications based on the skilled and intuitive guides, missile controls, fire control systems, intelligent stabilization, unstructured platform systems, infrastructure -missile, aerodynamic flow control, and many smart little projectiles. Several Army based Missile Research, Development, and Engineering teams are working tirelessly with the government and various industries to engineer MEMS based advanced devices which are able to withstand shocks, vibrations, and other environmental conditions with them through the Army missile system [4]. Instead of presenting a comprehensive report on the MEMS applications in the fields of military, this study discusses the various challenges of MEMS based technology empowered in the military and army. The applications and drawbacks on the performance, and the applications of MEMS devices are being discussed.

The study aims to focus mainly on the monitoring the level of shock that is required for monitoring the health of the missiles in order to monitor the performance after maintenance so as to eliminate the unwanted possible damages which can be caused. Sensitivity sensations are also in the interest of monitoring sensitive shipping management conditions and provide a quality control unit that is currently unavailable. The MEMS based shock detection sensor is designed for the purpose of shock monitoring crisis and has the ability to alert other hearing resources after a shock event. A Vital feature is that the power is only used in the event of a shock, which makes it ideal for long haul remote monitoring systems. The shock detector sensor is constructed, and visualized. High capacity with a low production cost will be enabled through the use of a MEMS technology like (DRIE) Deep reactive-ion etching processing [5]. A monitoring algorithm is administered so as to detect false alarm rejections to dormant faults and these tests are to be done during built in tests which are performed during maintenance procedures [6].

Military and army based arsenal administer internal sensors for the purpose of internal navigation, stabilization of the sensors for maximum efficiency, weapon launch control procedures. The main function of the internal navigation module is to provide details related to the statuses based on speed and attitude during its flight. These MEMS inertial sensors are powerful in strenuous environmental conditions mainly high power survival while the project is under the process of implementation, they are the most appropriate for low power consumption, vehicular and automobile applications. These inexpensive MEMS based IMUs are integrated for the process of internal navigation so as to maximize the Global Positioning System local receivers while for a short time period while the GPS exits [1].

The research deals with the development of CCHM. Captive Carry Health Monitor is an essential surveillance tool that is to be mounted upon the outer section or envelope of the fire weapon or missile to calculate and document the conglomerated time frame of a missile that was being fired to monitor the overall health of the missile. To identify seizure of the missiles, the Captive Carry Health Monitor tends to oscillate periodically creating a vibration pattern with a unique vibration rate using which the capacitive MEMS based accelerometer module that employs a broadband filter in order to capture the frequency that pairs with rotor harmonics, and is then contrasted with a certain RMS vibration rate having a low possible limit recorded during a flight. When a capture is obtained, the Captive Carry Health Monitor then evaluates the strength of the missile that was fired with the help of a magnetic sensor. With this method the Captive Carry Health Monitor can provide a higher accuracy rate in the quantification of the parameter related to the time and exposures of the missile that is fired.

Thus these components can enable the Captive Carry Health Monitor for its low power operation without must cost towards its power systems as it can operate for a decade with only two AA lithium ion powered batteries [7].

Wireless sensor applications for the monitoring of health have been launched in Pennsylvania State. These techniques are useful in the use of missiles, but military positions present a different problem. The problem deals with the issue of the integrity of these missiles kept in various locations by others unavoidable effects during the lifetime of transporting, storage and administration. The only best recommendation is that the inspection and repair is done at any expense. The Wireless Sensor Network is an emerging technology that enables the collection of information in a wide variety of wildlife monitoring environments in regions of military requirements. This wireless sensor based network contains of a set of sensors modules that use wireless connectors in order to perform a distributed distribution function. The modules are generally supplied with an embedded microprocessor with a very compact memory. The use of Wireless Sensor Network is adaptable and varied, but it actually requires a certain form of control, tracking, and monitoring. Basically the application Wireless Sensor Network is distributed onto a region where the data is to be monitored through its sensor modules. The Wireless Network Sensors will be used in military applications in the future [8]. Since these sensors modules are of low cost, the wrecking of these modules by hostile actions on the war zones will not disrupt any military operations. The attributes of resilience, pliability, and tolerance tend to make the sensory networks befitting for military based applications. The ongoing health monitoring of the military weapons systems using the MEMS based sensor modules faces issues with the proper integration of multiple sensor modules in order to form an efficient communication link. Other issues include: Higher life and low power consumption modules, remote connection link, reduction in the integrated package size and weight. In addition to military applications, MEMS based sensor modules has wider solicitations [9-26] in various other fields also.

CONCLUSION

Numerous military based applications and monitoring systems utilizing MEMS devices are discussed. Various sensors, natural sensors, and RF objects together form the base for highly mature MEMS devices. It is being observed that the MEMS based technologies can significantly improvise the capabilities of military equipment. Proper selection of MEMS technology to provide emerging

military deployments can directly improve performance, reduce integration costs, power consumption, improve efficiency, and overcome minute errors in systems can lead to dynamic changes in the field of Military Science.

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